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THE PROBLEM OF SPECIES IN THE NORTHERN BLUE FLAGS, IRIS VERSICOLOR L. AND IRIS VIRGINICA L.

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I. INTRODUCTION

The problem of species is a dual one. It asks two questions: What are species? How have they originated? In studying the nature of species we are first of all concerned with the extent to which the species of the orthodox taxonomists reflect actual divisions among plants and animals. Do such species, in the main, rest upon discrete natural groups of individuals or do they represent merely an artificial cataloguing device, ordering up, as best they may, the myriad forms occurring in nature.

It might be supposed that upon so fundamental a problem biologists would have come to some working agreement. Even the most casual survey of recent literature will show that this is far from being the case. While several of those who have committed themselves to print on the subject may use such phrases as "modern biologists recognize this to be the case," or, "all geneticists agree, etc., etc.," it is a noteworthy fact that no two of them are of the same shade of opinion. At one extreme are those who believe with Lotsy ('16) that, "The species is merely a

conception of the human mind and a very primitive anthropocentric conception in the bargain. * * * The species of the taxonomist is the comparative insignificant rest of large swarms of individuals which arose from the cross of two parents. * * * Species in the present taxonomic sense do not exist." On the other hand, we have such statements as Harper's ('23) "Linnean species do, by and large, constitute recognizable groups of more or less freely inter-breeding individuals. Only extremists deny the possibility of segregating and recognizing such units."

The disagreement as to species is just as extreme in regard to their size as in regard to their nature. If groups corresponding to our species do occur in nature, do they fit most readily into the species of the orthodox taxonomists (what we may call Linnean species for want of a better name) or would some other unit better express the relationships which we actually find among individuals? What are we to do with the vexed question of true-breeding sub-groups (variously termed micro-species, Jordanons, isoreagents) whose existence has been demonstrated for numerous Linnean species? Are we to retain them as significant sub-groups within the Linnean species, are we to treat them as of even greater importance, or are we to cast them out altogether?

It should be a relatively simple matter to answer these questions for any one species. A comprehensive survey of variation within the species over its entire range would show whether it were an independent unit or whether it merged into other forms; whether there were recognizable sub-groups within it; and what interrelationships obtained between the individuals which go to make up these sub-groups and the species itself.

However, such an intensive study should be able to contribute to other questions besides the nature of species. It should offer valuable evidence for the more popular question of their origin. During the last quarter of a century an attempt has been made to study evolution experimentally. In the course of these experiments two types of mutations have been observed in our laboratories and breeding plots. They have been thought to be the same sort of changes which, operating in the past, have brought about the evolution of our present-day forms. The first type of mutation has been shown to be due to changes which take

place at a particular point in the germ-plasm. Since only a single gene is affected, such changes have been called gene-mutations.

The second type of mutation has been shown to be due to re-alignments of the germinal material, to duplications of chromosomes or whole sets of chromosomes. The morphological results of these two types of mutation are quite dissimilar. An intensive and extensive survey of variation within a single species should therefore be able to demonstrate which of these two processes has been most active in causing progressive changes within that species. Such a study should, in other words, enable us to evaluate the evolutionary importance of gene-mutations and chromosomal re-alignments.

The present study is just such an intensive and extensive survey of two closely related species. It is an attempt to present a fairly complete picture of the variation within two natural groups of individuals over their entire range. It has as yet been almost purely morphological in scope. Though the morphological differences between individuals and groups of individuals undoubtedly rest upon basic physico-chemical ones, our knowledge of these physiological differences is as yet too incomplete, among the flowering plants, to possess much phylogenetical significance.

So far as is known, no such complete survey of variation within a species or group of species has ever before been made with plant material. It is an ambitious attempt for a single individual unless the problem be made as simple as possible. If we are to learn anything about the ultimate nature of species we must first of all reduce the problem to the simplest possible terms and study a few easily recognized, well-differentiated species. The group to be studied should therefore possess few sub-groups and intergrading forms. Unfortunately those species which have been selected for intensive study in the past have been chosen by reason of their very complexity.

The northern blue flags (*Iris versicolor* of the seventh edition of Gray's 'Manual') were accordingly chosen for the study, primarily, because they were a comparatively simple, stable, and well-marked group. They possessed certain other features which have materially reduced the labor involved in locating and study-

ing a large number of individuals. They are common, conspicuous, colonial, and perennial. Though the merits of these characters are practically self-evident, it may not be out of place to call attention to the colonial nature of *Iris versicolor* L. and its close relatives. Plants of these species are seldom found as isolated individuals but usually occur in colonies of a few to several hundred plants. Nor are these colonies merely the vegetative offspring of a single plant as is the case with so many colony-forming species. The individuals vary so strikingly in the size, shape, and color of their flowers, that at blooming time the limits of a single clone can readily be determined. These seldom exceed a few square feet, though exceptionally large clones do sometimes occur, as will be described below. It was the truly colonial nature of the blue flags which was particularly useful in the present study, making possible the examination of large numbers of plants in each locality with a minimum of effort.

An attempt was made to visit as much as possible of the range of the northern blue flags during their flowering season. Numerous colonies were studied in detail and measurements made on twenty to fifty individuals of the characters which had been selected for study. Representative plants were sent back from each of the colonies and established in an experimental plot at the Missouri Botanical Garden, where they were made the subject of genetical, morphological, and cytological studies.

In 1923 collections were made in central Michigan. In the spring of 1924 a trip was taken through northern Missouri, eastern Iowa, southern Wisconsin, central Michigan, western New York, and central New Hampshire. In 1925 collections were made in central Missouri, northwestern Arkansas, northern Ohio, including the Bass Islands, western and central New York, and southern Vermont. Fruiting material was collected that fall from central and northern New Hampshire and eastern Michigan. In the spring of 1926 a trip was taken through southern Illinois, southern Missouri, eastern Arkansas, western Tennessee, and central Kentucky. In June, collections were made in Missouri, Michigan, northern Vermont, Ottawa, Canada, and at Lake Timagami, in northern Ontario, Canada. In the early spring of 1927 another southern trip was taken, principally

to collect material from Mississippi and Alabama. In June of that year collections were made in Ohio, Maryland, Pennsylvania, New York, Ontario, northern Michigan, and Wisconsin. In 1928

Fig. 1. Localities at which *I. versicolor* and *I. virginica* have been studied.

North and South Carolina and eastern Tennessee were visited in early May. With the exception of the extreme north the territory has now been quite thoroughly covered as shown by the map in fig. 1.

Extensive collections of flowering material preserved in alcohol and of ripe seed capsules were made at several points by Mr. R. E. Woodson, Jr. and by the writer. The work on the fresh and preserved material has been supplemented by taxonomic studies in the herbarium of the Missouri Botanical Garden and at various other herbaria.

ACKNOWLEDGEMENTS

It is scarcely possible to carry on a study involving geographical distribution without enlisting the help of a very large number of people. For aid in assembling information and material for study it is a pleasure to acknowledge the cooperation of those whose names are listed below, and of several others who have been inadvertently overlooked:

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making the collections and tabulating the data. It is a pleasure to acknowledge his helpful companionship and material aid.

II. Taxonomy and Morphology

History of the species

It has been found that what commonly passes for *Iris versicolor* L. is made up of two species. One, inhabiting New England, New York, Pennsylvania, northern Ontario, and northern Michigan, has lanceolate petals much shorter than the sepals, a short ovary, and shiny D-shaped seeds. The other extends in the middle-western states from the Great Lakes to the Gulf of Mexico and up the Atlantic seaboard to southern Virginia. It has obovate-spatulate petals which are nearly as long as the sepals, a long ovary, and dull, round or D-shaped seeds. As will be brought out in Parts III and IV of this paper, the species are wholly distinct and crosses between them are partially sterile. Their distribution is shown in more detail in fig. 1.

It now becomes necessary to determine their relation to the species named by Linnaeus. In the first edition of the 'Species Plantarum' he named, as numbers 10 and 11, two similar American irises. To the first, which he named *Iris versicolor*, he referred numbers 187 and 188 of Dillenius and the *Iris latifolia Virginiana* etc. of Ehret. The second he named *Iris virginica*, basing it upon Gronovius' *Iris corollis imberbibus*, etc. The two species of *Iris* studied by the writer are very similar to each other and, like many other species of the genus, are difficult of recognition in ordinary herbarium specimens. Were it not for the fact that we have such ample material it might be difficult, if not impossible, to determine the relation between the names given by Linnaeus and these two common species of eastern North America.

Fortunately there are such good illustrations and such excellent herbarium specimens that there can be no doubt that the common blue flag of the East and North is identical with *Iris versicolor* of Linnaeus and that the species of the South and Middle West is identical with his *Iris virginica*.

For *Iris versicolor* I have studied figs. 187 and 188 of Dillenius, Tab. VI and VIII of Ehret (pl. 35), and a photograph (pl. 36, fig. 1) of Dillenius' specimen in his herbarium at Oxford. Ehret's

excellent figures leave no doubt about the identification. Particularly to be noticed are the short ovary, the lack of auricles on the dissected style, the broad-bladed sepal, and the lanceolate petals. Dillenius' figure and his specimen show very small petals; the herbarium specimen in addition has a short ovary.

In the case of *Iris virginica*, I have examined Clayton's No. 259 at the British Museum, and Linnaeus' own specimen of *Iris virginica* at the Linnaean Society. Both are in an excellent state of preservation and each shows heavy pubescence on the blade of the sepal.

Jacquin's plate of *Iris virginica* is an excellent figure of *Iris versicolor*. It shows a plant with small petals, sepals with no trace of a yellow eye, and long pedicels.

The plate (pl. 36, fig. 2) accompanying Radius' description of *Iris carolina* shows it to be identical with *Iris virginica*. The sepal and petal are both waved, a character often assumed by *Iris virginica*, never by *Iris versicolor*. The petals are nearly as long as the sepals, and according to the description the plants have few flowers. Furthermore, the species is distinguished from *Iris virginica* of Linnaeus, according to Jacquin, which as we have seen, is *Iris versicolor* of Linnaeus.

Plants from the same general region were described as *Iris caroliniana* by Watson in 1898. In his description he speaks of "the elliptical blade lilac, veined with purple and with a yellow spot reaching to the center." The petals are described as oblong-spatulate. The type specimen, in the Gray Herbarium, shows the typical roundish seeds with a spongy surface, which characterize *Iris virginica*. Material from practically the same locality was studied in the spring of 1928 by the writer. When large numbers of plants were examined there was found to be no consistent difference of any sort between the irises of the Carolina Coastal Plain and those of the Mississippi Valley. There is therefore no ground for maintaining *Iris Shrevei* of Small. He distinguishes it from *Iris versicolor* but makes no mention of its relationship to *Iris carolina* (*Iris virginica* L.), with which it is identical. The illustration accompanying his description is evidently made from a badly stunted plant. Specimens collected from the same locality visited by Small are much larger than those

in his illustration. The locality was visited when the plants were in full bloom and nearly all bore the bright yellow-pubescent spot on their sepals which shows in his illustration of *Iris carolina* but is lacking from his illustration of *Iris Shrevei*. Furthermore, plants transplanted from that locality to the experimental garden have borne as many round as D-shaped seeds, though his illustration shows only a D-shaped seed.

COMPARATIVE MORPHOLOGY

Distinguishing differences in italics. See also pls. 37–39, 41–43.

IRIS VIRGINICA L.	IRIS VERSICOLOR L.
ROOTSTALK	
A creeping rhizome *2.0–4.0* cm. in diameter. Stele, in fresh specimens, yellowish white to dirty yellow. Cortex pale pinkish white.	A creeping rhizome *1.0–2.5* cm. in diameter. Stele, in fresh specimens, yellowish white to dirty yellow. Cortex pale pinkish white.
ROOTS	
Wrinkled, *2–4 mm.* in diam., white.	Wrinkled, *1–3 mm.* in diam., white.
LEAVES	
Narrowly ensiform, *1–5 cm.* broad, gray-green, often flushed with purple below.	Narrowly ensiform, *0.5–3.0 cm.* broad, gray-green, often flushed with purple below.
STEM	
Sparingly branched above, green or greenish purple.	*Freely branched* above, green or greenish purple.
SPATHE VALVES	
4–12 cm. long, *occasionally* becoming foliaceous.	*3–4.5 cm.* long, *never* becoming foliaceous.
PEDICELS	
2.5–8.0 cm. long in the flower, *rarely equalling* the longest spathe valve.	*1.0–3.0 cm.* long in the flower, *often equalling or surpassing* the longest spathe valve.
OVARY	
1.8–3.8 cm. long in the flower; ovary wall relatively *thick; ovules nearly filling locules at anthesis.*	*0.8–2.0 cm.* long in the flower; ovary wall relatively *thin; ovules filling scarcely half the locules at anthesis.*
TUBE	
Wall of tube *thick, conspicuously glandular, closely appressed to style base within.*	Wall of tube *thin, not conspicuously glandular, style base distinctly separate from tube.*

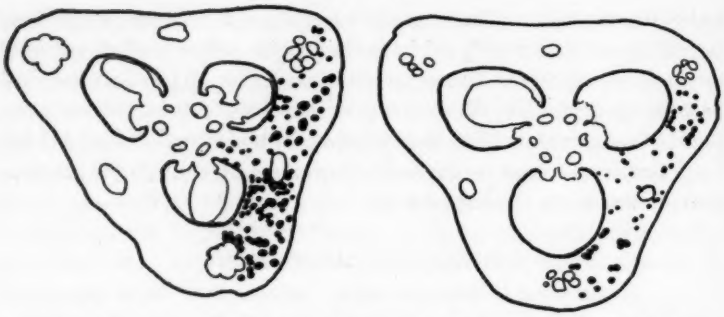

Fig. 2. Camera-lucida drawing of cross-sections of ovaries of *I. versicolor* (right) and *I. virginica* (left), resin ducts in black, vascular bundles outlined; × 10.

SEPALS	
4.0–8.4 cm. long, *1.6–4.0 cm.* broad; blade of sepal *oblong-ovate* to *ovate*, usually some shade of *bright blue*, although white and lavender specimens have been found.	*4.0–7.2 cm.* long, *1.8–4.0 cm.* broad; blade of sepal *ovate* to *reniform-ovate*, usually some shade of *purplish-blue*, although white and lavender specimens have been found.
Blade bearing a bright yellow conspicuously pubescent spot at the base.	*Blade often without a conspicuous spot at the base; when present, greenish or greenish yellow.*
Hairs of the pubescence *conspicuous* and *macroscopic, longer* than the thickness of the sepal.	Hairs of the pubescence *inconspicuous* and *microscopic, shorter* than the thickness of the sepal.
PETALS	
Oblong-lanceolate to *oblong-spatulate, 3.0–7.0 cm.* long, *1.0–3.0 cm.* broad, *often* (in about 50 per cent of the cases) notched at the apex, of the same general color as the sepals, *delicate in texture, easily bruised, wilting readily.*	*Lanceolate* to oblong-lanceolate, *2.2–5.4 cm.* long, *0.5–2.2 cm.* broad, *very rarely* notched at the apex, of the same general color as the sepals; *firm in texture, not readily wilting.*
STYLE	
Style branches *inwardly auriculate* at their convergences.	Style branches *not auriculate* at their convergences, *or at most but weakly so.*
STYLE CRESTS	
Reflexed, variously toothed, *0.7–2.0 cm.* in height.	Reflexed, variously toothed, *0.7–1.5 cm.* in height.
Stigma a triangular tongue.	Stigma a triangular tongue.
STAMENS	
Anthers *0.9–2.1* cm. long.	Anthers *0.7–1.6* cm. long.
Pollen-grains oblong-ovate in outline.	Pollen-grains oblong-ovate in outline.

CAPSULE	
Capsular lining *irregularly* minute-striate; inner surface *mainly dull.*	Capsular lining *regularly* minute-striate, giving the inner surface a *uniformly shiny* appearance.
SEEDS	
Round to D-shaped in outline. Seed-coat *corky* and *dull*, the surface appearing *irregular, with occasional broad depressions* under a hand-lens.	*Always D-shaped* in outline. Seed-coat relatively *thin, hard,* and *shiny*, the surface appearing *regularly pitted*, the *pits in definite rows* under a hand-lens,

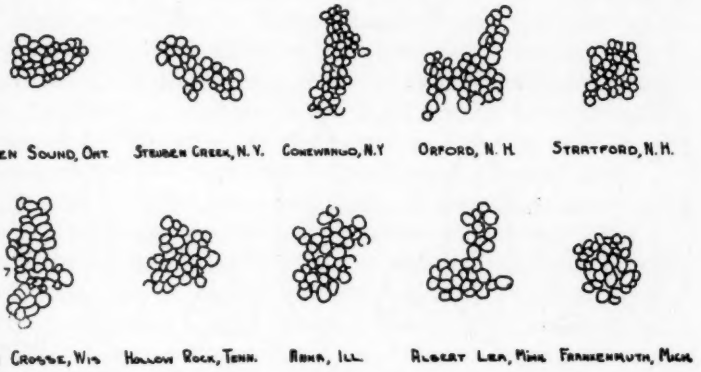

Fig. 3. Camera-lucida drawings of cells in outer seed-coat: upper row, *Iris versicolor*, lower row, *I. virginica;* × 20.

GEOGRAPHICAL DISTRIBUTION

It is planned to give a detailed discussion of the distribution of the two species in a later section. Until then certain outstanding points may be briefly summarized.

Iris versicolor is generally a northern and eastern species, *Iris virginica* a southern and central-western one. As shown by the map in fig. 1, *Iris versicolor* occurs in New England, New York, Pennsylvania, northern Michigan, Wisconsin, and Minnesota, and eastern Canada, *Iris virginica* extends from the Gulf states to central Michigan and Wisconsin and west to the eastern edge of Nebraska and Kansas. On the Atlantic coast it is common in the Carolina Coastal plain, though it is rare in the mountains and was not seen in the Piedmont.

At their zone of contact in Michigan, Wisconsin, and Minnesota, the range of *Iris versicolor* coincides very nearly with the northern

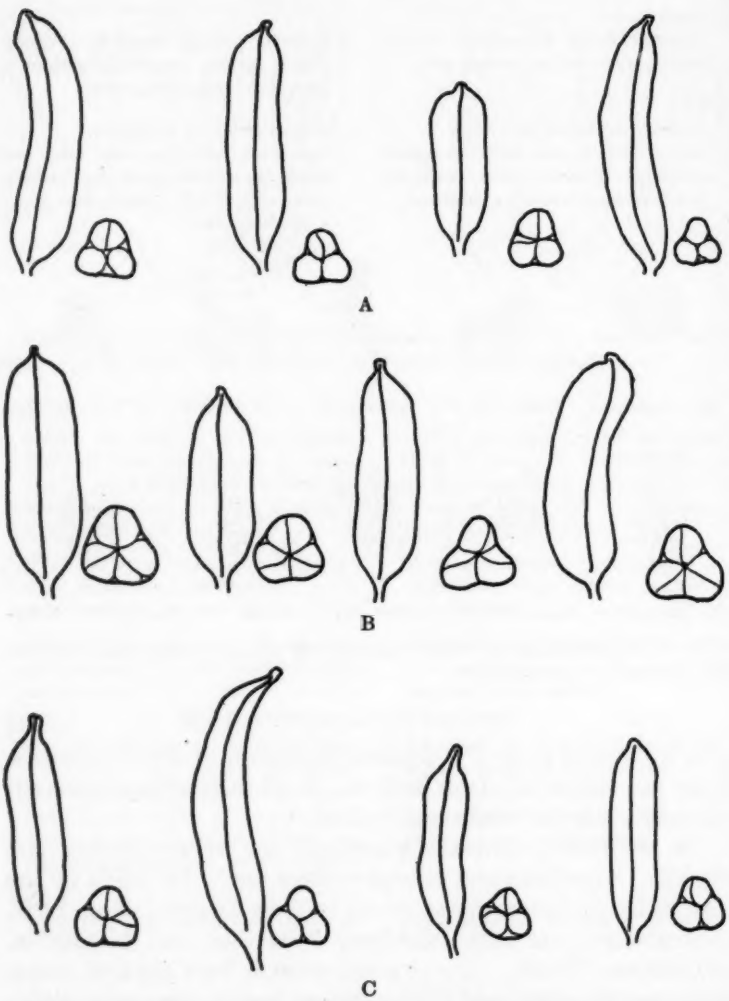

Fig. 4. Camera-lucida drawings of seed capsules showing outline and cross-section with seeds, × ⅓: *A*, *I. virginica*, from La Crosse, Wis.; *B*, *I. versicolor*, from Conewango, N. Y.; *C*, *I. virginica*, from Bonnieville, Ky.

coniferous forest, that of *Iris virginica* with the southern hardwoods.

Both species, while distinctly moisture-loving, belong to the border zone between marsh and dry land. They are not able to compete successfully if the situation is wet enough for *Typha* or dry enough for grasses. In those regions which have been completely drained and brought under cultivation they have very nearly disappeared. None were found in the drained areas of southeastern Missouri, though the species was formerly common there. Several local naturalists have reported that *Iris virginica* was much commoner in Tennessee and North Carolina before the lowlands in these states were brought under cultivation. In those sections of the country, on the other hand, where such areas have been left as pasture lands, both species have increased. Livestock eat the grass in preference to the Iris, and the iris colonies spread out vigorously, often covering several acres.

The seeds of both species float easily, and seedlings can often be observed coming up on wet sandy beaches of the Great Lakes. It would not be surprising to find *Iris virginica* establishing itself locally along the St. Lawrence River system. Two such colonies have actually been found: one on a deserted lake beach at Saint Ignace, and one on the shores of the Niagara River a few miles above the Falls on the American side.

ABBREVIATIONS

The abbreviations used to indicate the herbaria in which the specimens occur are as follows:

ASP = Academy of Natural Sciences of Philadelphia.
BM = British Museum.
MBG = Missouri Botanical Garden.
US = United States National Herbarium.

TAXONOMY

Iris versicolor L. Sp. Pl. ed. 1, 39. 1753; Curtis, Bot. Mag. **1**: *pl. 21.* 1790; Redouté, Liliacées **6**: *pl. 339.* 1812; Edwards, Bot. Gard. **2**: *pl. 30, fig. 2.* 1812; Baker in Gard. Chron. N. S. **6**: 614–615. 1876; Meehan, Native Flowers & Ferns **1**: *pl. 36.* 1878; Millspaugh, Med. Plants **2**: *pl. 173.* 1892; Britton & Brown, Ill. Flora, ed. 1, **1**: 448, *pl. 1069.* 1896, in part; Small, Fl. Southeast. U. S. 306. 1903, and ed. 2,305. 1913, in part;

Gray's Manual, ed. 7, 299. 1908, in part; Britton & Brown, Ill. Flora, ed. 2, **1**: 537, *pl. 1328*. 1913, in part; Dykes, Genus Iris, 79–81. 1913, in part; Small, Addisonia **9**: 55–56, *pl. 316*. 1924. Pls. 38, 40, 41 (left fig.); 42 fig. 2; 43 figs. 6–10.

[*Iris americana versicolor stylo non crenato* Dillenius, Hort. Eltham. t. 155, *pl. 187*. 1732.]

[*Iris americana versicolor stylo crenato* Dillenius, Hort. Eltham. t. 155, *pl. 188*. 1732.]

[*Iris latifolia Virginiana* . . . . .Ehret, Plantae Depictae *pl. 6 & 8*. 1748.]

Iris virginica L. acc. to Jacquin, Icones Plant. Rariorum **2**: *pl. 223*. 1786–1793.

Iris virginica L. Sp. Pl. ed. 1, 39. 1753; Michx. Fl. Bor. Amer. 22. 1803; Sims in Curtis' Bot. Mag. **19**: *pl. 703*. 1804; Baker in Gard. Chron. N. S. **6**: 615. 1876.

Pls. 34, 37, 39, 41 (right fig.); 42 figs. 1, 3, 4; 43 figs. 1–5; 44.

[*Iris corollis imberbibus*. . . . . .Gronovius, Flora Virginica, 11. 1739.]

Iris carolina Radius, Naturforsch. Ges. Leipzig Schrift. **1**: 158, *pl. 3*. 1822; Small, Addisonia **9**: 49–50, *pl. 313*. 1924.

Iris versicolor L. in part; Britton & Brown, Ill. Flora, ed. 1, **1**: 448, *pl. 1069*. 1896; Small, Fl. Southeast. U. S. 306. 1903, and ed. 2, 305. 1913; Gray's Manual, ed 7, 299. 1908; Britton & Brown, Ill. Flora, ed. 2, **1**: 537, *pl. 1328*. 1913; Dykes, Genus Iris, 79–81. 1913.

Iris caroliniana Wats. in Gray's Manual, ed. 6, 514. 1890; Baker, Handbook Irid. 12. 1892; Sargent, Gard. & Forest **6**: 334–335. 1893; Britton & Brown, Ill. Flora, ed. 1, **1**: 449, *pl. 1071*. 1896; Wats. in Proc. Am. Acad. **25**: 134. 1898; Small, Fl. Southeast. U. S. ed. 1, 306. 1903, and ed. 2, 305. 1913; Gray's Manual, ed. 7, 300. 1908; Stapf in Curtis' Bot. Mag. IV, **8**: 94, *pl. 8465*. 1912.

Iris versicolor L. var. *virgimea* L., ex. Baker (err. typ.), Handbook Irid. 12. 1892.

Iris georgiana Britton in Britton & Brown, Ill. Flora, ed. 2, **1**: 537, *pl. 1330*. 1913.

Iris Shrevei Small, Addisonia **12**: 13-14, *pl. 391*. 1927.

IRIS VERSICOLOR L.

Specimens examined:

CANADA:

NOVA SCOTIA: Canso, July 24, 1901, *Ward* (US); Sable Is., Aug. 16, 1913, *St. John 1184* (US).

NEW BRUNSWICK: Campobello Is., July 8, 1880, *Smith* (US).

ONTARIO: Lincoln Co., June 10, 1897, *McCalla* (US); Paris, vicinity, July 4, 1926, *Mathias 636* (MBG).

UNITED STATES:

MAINE: St. John River, July 22, 1917, *St. John & Nichols 2230* (US); Westbrook, June 8, 1906, *Ricker 50* (US); Fort Kent, river flats, July 10, 1908, *Mackenzie 3422* (MBG); Seal Harbor, swamp, June 28, 1887, *Redfield 7117* (MBG); St. Francis, gravelly shore of St. John River, Aug. 5, 1893, *Fernald 147* (MBG).

NEW HAMPSHIRE: Peterborough, Aug. 20, 1913, *Batchelder* (ASP); Shelburne, June 17, 1915, *Deane* (US); Shelburne, Oct. 28, 1915, *Deane* (US); Connecticut Lakes, Oct. 20, 1895, *Stevens* (US).

VERMONT: Brandon, swale, June 6, 1921, *Dutton* (MBG); So. Burlington, July 8, 1914, Knowlton (ASP).

MASSACHUSETTS: Dedham, June 13, 1897, *Greenman 2333* (MBG); Brookline, June 26, 1896, *Greenman 2321* (MBG); Granville, meadow brook, June 20, 1914, *Seymour 174* (MBG); So. Framingham, May 31, 1890, *Sturtevant* (MBG); Cambridge, May 29, 1901, *Floyd* (MBG); Nantucket, pond margin, July, 1923, *Mason* (MBG); Ashland, wet grounds, *Morong* (MBG); Nonquit, June 5, 1888, *Sturtevant* (MBG); Woods Hole, July 26, 1911, *Pennell 3164* (ASP); Wilbraham, June 12, 1876, *Pillsbury* (ASP); Boston, 1816, *Boott* (US); Marthas Vineyard, June 29, 1916, *Seymour 6158* (US); Nantucket, June 2, 1900, *Day 64* (US); Marthas Vineyard, Aug. 1888, *Harrison* (US).

CONNECTICUT: Middletown, May, 1836, *Bigelow* (MBG); exact locality and date lacking, *Wright* (MBG); Stratford, June 7, 1893, *Eames* (US).

NEW YORK: Otis Summit, July 27, 1903, *Williamson* (ASP); St. Regis Falls, June 28, 1903, *Hudson 31* (US); Ithaca, June 23, 1885, *Coville* (US); Van Courtlandt, June, 1893, *Pollard* (US); N. Harpersfield, June 21, 1906, *Topping* (US); Elizabethtown, swamps,

July 2, 1875, *Redfield 7911* (MBG); Ithaca, June 4, 1877, *Trelease* (MBG); east of Cherry Valley, July 2, 1926, *Mathias 652* (MBG); banks of Lake George, Aug. 24, 1856, *Engelmann* (MBG); locality lacking, 1840, *Short* (MBG); Bedminster, meadows, date lacking, *Perry* (MBG).

NEW JERSEY: Vineland, Sept. 12, 1923, *Bassett & Long* (ASP); Camden, May 22, 1922, *Bassett* (ASP); Quaker Bridge, Sept. 11, 1923, *Dreisbach 1834* (ASP); Folsom, June 10, 1911, *Long 5940* (ASP); Cor's, Ocean Co., Oct. 11, 1910, *Long 5582* (ASP); Cold Spring, Cape May Co., June 1, 1911, *Brown* (ASP); Atlantic City, margin of meadows, June 3, 1875, *Redfield 7910* (MBG).

PENNSYLVANIA: Lester, Delaware Co., May 28, 1912, *Findlay* (ASP); Chester Co., June 4, 1905, *Weston 164* (US); Harrisburg, Aug. 13, 1888, *Small* (US).

MARYLAND: Spesutic Is., May 25, 1879, *Smith* (US); Chestertown, Aug. 18, 1900, *Vanata* (ASP).

DISTRICT OF COLUMBIA: Washington, May and June, 1878, *Ward* (US).

MICHIGAN: Cheboygan Co., sedge pool, July 17, 1917, *Gates & Gates 10597* (MBG); Douglas Lake, Cheboygan Co., July 17, 1916, *Ehlers* (MBG); Burt Lake, Cheboygan Co., July 4, 1917, *Gates & Gates 10492* (MBG); L'Anse Co., July, 1892, *Eby* (MBG); Keweenaw Peninsula, Aug. 1878, *Engelmann* (MBG).

WISCONSIN: La Pointe, Sept. 3, 1878, *Engelmann* (MBG).

IRIS VIRGINICA L.

Specimens examined:

UNITED STATES:

DISTRICT OF COLUMBIA: Alexander Is., May 15, 1915, *Van Eseltine 366* (US).

VIRGINIA: Norfolk Co., May 11, 1898, *Kearney 1079* (US); exact locality and date lacking, *Clayton 259* (BM).

NORTH CAROLINA: Hendersonville, wet meadows, May 26, 1898, *Biltmore Herb. 542b* (MBG, US); Roandale Farm, June 8, 1895, *Wetherby 1067* (US).

SOUTH CAROLINA: Cat Island, Georgetown Co., Aug. 16, 1915, *Alexander 111* (US, NY).

OHIO: Middleburg, Cuyahoga Co., June 20, 1897, *Watson*

(MBG); Clare, Hamilton Co., spring-fed swamp, May 30, 1906, *Braun* (MBG).

KENTUCKY: Elizabethtown, May 23, 1926, *Anderson & Woodson 38* (MBG); exact locality and date lacking, *Short* (MBG); Bowling Green, swamp, May 21, 1897, *Price* (MBG); Drake's Creek, Warren Co., May, 1891, *Price* (MBG); Livermore, McLean Co., June 2, 1920, *E. J. Palmer 17707* (MBG); Ohio City, swamp, June 5, 1901, *Price* (MBG); Clay City, May 23, 1903, *Biltmore Herb. 542* (US).

TENNESSEE: Stanton, May 20, 1926, *Anderson & Woodson 60* (MBG); Knoxville, wet ground, May 1896, *Ruth* (MBG).

GEORGIA: McQueen Is., Chatham Co., brackish marshes, April 30, 1904, *Harper 2180* (MBG).

FLORIDA: Lake City, May 23, 1897, *MacKenzie* (MBG).

MICHIGAN: Adrian, June 24, 1901, *Dewey 508* (US); Ann Arbor, June 10, 1884, *Sudworth 50* (US); Flint, swamp, June 18, 1923, *Anderson* (MBG).

INDIANA: Terre Haute, May 19, 1889, *Evermann* (US); Roby, June 18, 1910, *Lansing 2789* (US); Miller's, May 30, 1902, *Chase 1799* (US).

ALABAMA: White River marshes, April 14, 1898, *Mohr* (US); Hollywood, May 15, 1902, *Biltmore Herb. 542g* (US); Pearlington, April 8, 1880, *Mohr* (US); Mobile, May 16, 1893, *Mohr* (US).

ILLINOIS: Spoon River, Stark Co., June 9, 1907, *Chase 1425* (US); Macon Co., June 12, 1915, *Clokey 2433* (US); Morgan Park Ridge, May 27, 1907, *Dixon & Gage 702* (US); Kankakee, May 27, 1913, *Crampton 124* (US); Decatur Co., May 29, year lacking, *Clokey* (MBG); French Village, St. Clair Co., May 27, 1903, *Eggert* (MBG); Olney, April 14, 1921, *Ridgway 1381* (MBG); Fish Lake, St. Clair Co., July 16, 1858, Norton (MBG); Woodlawn, Jefferson Co., May 16, 1898, *Eggert* (MBG); Decatur, date lacking, *Clokey 2789* (MBG); Shawneetown, swampy borders of lake, June 19, 1919, *E. J. Palmer 15554* (MBG); Reevesville, Johnson Co., low swampy open ground, June 3, 1919, *E. J. Palmer 15350* (MBG); Mounds, Pulaski Co., May 7, 1919, *E. J. Palmer 15074* (MBG).

MISSISSIPPI: Beauvoir, March 28, 1898, *Tracy 4463* (MBG).

MINNESOTA: Nicollet, June, 1892, *Ballard* (US); Swan Lake,

July 16, 1917, *Metcalf 40* (US); Fort Snelling, June 22, 1888, *Forwood* (US).

IOWA: Tiffin, June 5, 1909, *Somes 3132* (US); Fayette Co., June 5, 1894, *Fink 37* (US); Hamilton Co., July 1891, *Rolfs* (MBG); Missouri Valley, June 21, 1897, *Pammel 587* (MBG); Iowa City, date lacking, *Hitchcock* (MBG); Armstrong, Emmet Co., June 18, 1897, *Cratty* (MBG); Ames, June 21, 1897, *Ball & Meeker 524* (MBG).

MISSOURI: St. Louis Co., June 1912, *Craig* (MBG); Oakwood, Ralls Co., open woods, June 19, 1917, *Davis 7553* (MBG); Randolph, May 18, 1895, *Mackenzie 544* (MBG); Jackson Co., low wet ground, common, June 17, 1892, *Bush 1475* (MBG); Jefferson City, June 1870, *Krause* (MBG); Carthage, swamps, May 27, 1906, *E. J. Palmer 883* (MBG); Kimmswick, May 23, 1885, *Wislizenus 407* (MBG); Winfield, Lincoln Co., June 7, 1916, *Davis 1456* (MBG).

ARKANSAS: Nettleton, May 7, 1893, *Eggert* (MBG); Craighead, lakes, May 7, 1893, *Eggert* (MBG).

LOUISIANA: Hammond, April 4, 1889, *Gallup 16* (US); Minden, April 14, 1901, *Trelease* (MBG); Madisonville, May 5, 1888, *Joor* (MBG); Covington, April 1920, *Arsene 12400* (US).

NEBRASKA: Nebraska City, June, 1889, *Webber* (MBG).

KANSAS: Wyandotte, moist places, Aug. 5, 1897, *Clothier 1067* (MBG, US).

TEXAS: Troupe, May 9, 1902, *Reverchon 2793* (MBG, US); Orange, April 19, 1899, *Bray 61* (US); Keechi, Leon Co., April 20, 1918, *E. J. Palmer 13420* (MBG); Beaumont, Jefferson Co., April 22, 1916, *E. J. Palmer 9522* (MBG).

III. INTRA-SPECIFIC VARIATION IN IRIS VERSICOLOR AND IRIS VIRGINICA

Wherever either species was studied, the individual plants which went to make up a colony were found to vary strikingly among themselves. They varied in every conceivable characteristic, both vegetative and floral, though the latter variations were the most conspicuous. The flowers varied in size and form, in color and color pattern, in number and arrangement, in texture, and in odor. Plate 34 shows such of these differences as can be

Three flowers each of six plants of *Iris virginica* from Portage des Sioux, Mo.

recorded by the camera for six individuals from a typical colony, that of *Iris virginica* at Portage des Sioux, Missouri. They are not selected extremes but are the first six individuals which were located with at least three flowers apiece. The pictures were taken under uniform conditions as regards lighting, exposures, development, etc., and such differences as occur are due to differences in the color and texture of the flowers themselves. It may not be out of place to call attention to some of the differences which obtain between these six plants, since they are similar to the differences which were met with everywhere throughout the study.

Plant No. 1. Petals narrow and ruffled, ovary short.
Plant No. 2. Petals flat and wide, flower pale blue in color.
Plant No. 3. Entire plant large and robust, of great vegetative vigor, clone covering half an acre, flowers marked with dark blue veins on a light background, spot on sepal large and brilliant.
Plant No. 4. Flowers small and light colored, sepals broadly spatulate.
Plant No. 5. Flowers pale gray-blue, sepals long and narrow, stems and leaves very short, plant floriferous.
Plant No. 6. Flowers dark reddish blue, ovary short, stems slender, few-flowered.

In order to summarize and average such differences as these it becomes necessary to select a few for concentrated study. The characters chosen should fulfill three conditions; they should be easily measurable; they should show some variability; and they should not be easily affected by environmental influences. The first qualification eliminates a number of very conspicuous differences, such as color and color pattern, which are not adapted to quick and accurate measurement. The second bars those characters, such as the length of the anther, which are practically indentical for a large number of species of *Iris*. All of the characteristics of the plant are, of course, open to the objection that they are affected by the environment but some of them are much more stable than others. The leaf characters are particularly poor. The largest leaf on a plant may be two or three times

as wide as the smallest. The size and shape of the seed capsules are likewise extremely variable on the same plant in different seasons and under different conditions. In general the dimensions of the floral elements are less easily affected, and since they are of predominant importance from a taxonomic standpoint they were very largely used in the present work.

After a year's preliminary study, seven characters were chosen for measurement and have been used throughout the work. Five others were subsequently tried extensively, and three of these are being used at the present time. The characters chosen and the exact manner in which measurements were taken are shown in fig. 5.

These characters are measured as follows:

Sepal length. This is the maximum length of the sepal from the base of the stamen to the tip.

Sepal width. The maximum width at right angles to the length.

Sepal taper. Distance from the tip to the point of maximum width.

Petal length. Unfortunately there was no exact lower boundary as in the case of the sepal, and some of the variation in the earlier measurements is due to the fact that different points were used as a base. It was eventually defined as the line between the bases of the lateral flanges at which it breaks off naturally when pulled over backward.

Petal width. The maximum width at right angles to the length.

Petal taper. The distance from the tip to the point of maximum width.

Crest. The maximum length of the appendages of the stigma, measured from their tips to a line connecting the ends of the stigmatic lip.

Ovary. The junction of the ovary and pedicel is distinct in both species; that between the ovary and the tube is much less so, being marked by a vague ridge. The summit of this ridge is taken as the line of demarcation and the ovary is measured from it to the base.

Tube. The tube is measured from the same point to the base of the stamen, one sepal having been removed.

Stamen. The length of the anther from the attachment of the filament to the tip.

Care was taken to measure only fully opened, uninjured flowers. Not more than one flower of a clone was measured (except in those few cases where intra-clonal variation was being studied). It was found upon experiment that one single set of measurements gave almost as consistent results as when *two* sepals and *two* petals were measured on each plant. An experiment was made on the

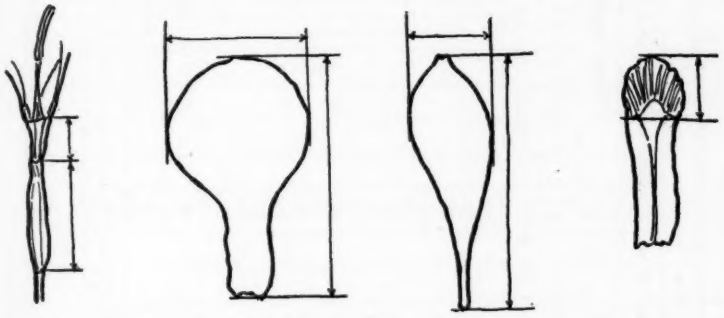

Fig. 5. Diagram showing how floral elements of *Iris* were measured.

colony at Portage des Sioux, Missouri, to determine if the measurements were being affected by the flowers not being fully expanded. Twenty flowers were measured at four o'clock in the afternoon and remeasured at seven the next morning with practically identical results.

The first five year's measurements have been summarized in tables I–IV. The figures in italics are the class containing the median or mid value. The median has been used as an average rather than the mathematical mean, since it is less influenced by occasional extreme values. The extra-small size of a frost-bitten or insect-mutilated petal, for instance, is not really significant, yet a single such extreme observation might seriously influence the position of the mathematical mean. It would have no more effect on the position of the median than would any petal of less than average size.

One fact is immediately apparent from an inspection of the summary. No single measurement will serve as a criterion for

TABLE I

IRIS VIRGINICA

Year	Town	State	Individuals of each colony classified according to size																													
			Petal length in centimeters														Total number	Sepal length in centimeters														Total Number
			1.9–2.2	2.3–2.6	2.7–3.0	3.1–3.4	3.5–3.8	3.9–4.2	4.3–4.6	4.7–5.0	5.1–5.4	5.5–5.8	5.9–6.2	6.3–6.6	6.7–7.0	7.1–7.4		3.7–4.0	4.1–4.4	4.5–4.8	4.9–5.2	5.3–5.6	5.7–6.0	6.1–6.4	6.5–6.8	6.9–7.2	7.3–7.6	7.7–8.0	8.1–8.4		
1927	Kimborough	Ala.	...	...	...	...	...	...	...	7	5	*8**	5	...	...	...	25	...	...	...	...	4	6	*8*	8	3	...	1		25
1927	Wiggins	Miss.	...	...	...	...	...	...	1	...	2	4	4	...	1	...	12	...	...	...	...	...	3	...	*6*	1	1	1	...	12
1927	Jackson	Miss.	...	...	...	...	...	...	8	*5*	5	2	1	...	...	...	21	...	...	...	2	7	*8*	3	5	1	...	...	...	21
1926	Arlington	Tenn.	...	...	...	...	...	...	...	7	*6*	2	1	1	...	...	17	...	...	...	...	6	*5*	3	2	1	...	...	...	17
1926	Huntingdon	Tenn.	...	...	...	...	...	...	2	1	2	2	...	...	...	...	7	...	...	...	...	1	1	2	1	2	...	...	...	7
1926	Camden	Tenn.	...	...	...	...	...	...	1	8	13	*15*	7	3	3	...	50	...	...	...	1	1	7	15	*11*	7	3	5	...	50
1926	Bonnieville	Ky.	...	...	...	...	...	...	1	...	8	*11*	11	4	...	...	35	...	...	...	...	1	5	8	*8*	9	3	1	...	35
1926	Elizabethtown	Ky.	...	...	...	...	...	...	1	1	3	3	3	...	...	...	11	...	...	...	...	1	1	1	6	2	...	...	...	11
1926	Stanton	Ky.	...	...	...	...	...	1	8	*8*	3	1	...	...	...	...	21	...	...	1	4	*7*	6	3	...	...	...	...	...	21
1926	Hayden	Ind.	...	...	...	...	...	2	2	*5*	4	3	1	...	...	...	17	...	...	...	2	5	*5*	6	1	...	...	...	...	19
1926	Anna	Ill.	...	...	...	...	...	2	6	*16*	5	8	1	1	...	...	39	...	...	...	2	4	8	*14*	8	2	...	...	...	38
1925	Vulcan	Ill.	...	...	...	...	...	1	3	4	*7*	6	5	...	...	...	26	...	...	1	2	2	7	*8*	2	3	2	...	...	27
1926	Vulcan	Ill.	...	...	...	...	...	1	...	4	*5*	5	...	...	...	...	15	...	...	...	...	1	3	*8*	2	1	...	...	...	15
1924	East St. Louis	Ill.	...	...	...	...	...	...	2	3	6	*8*	4	...	...	...	23	...	...	1	...	2	2	*8*	4	3	1	...	...	21
1925	Farmington	Ark.	...	...	...	...	...	...	4	2	*14*	8	9	1	...	...	38	...	...	...	...	6	7	*10*	7	6	1	1	...	38
1926	Pilot Knob	Mo.	...	...	...	...	...	...	...	2	...	4	1	1	...	...	8	...	...	...	...	...	2	2	...	3	1	...	...	8
1925	Wicks	Mo.	...	...	...	...	2	10	*10*	10	8	3	...	...	...	...	43	...	...	1	6	13	*8*	8	5	2	...	...	...	43
1926	Valley Park	Mo.	...	...	...	...	...	1	1	*11*	7	2	...	...	...	...	22	...	...	1	...	1	*10*	7	2	1	...	...	1	23
1925	P. des Sioux	Mo.	...	...	...	...	...	...	5	1	...	...	...	...	...	...	6	...	...	...	1	1	2	1	1	...	...	...	...	6
1926	P. des Sioux	Mo.	...	...	...	...	3	7	9	*11*	6	3	1	...	...	...	40	...	...	2	3	13	*10*	5	7	...	...	...	...	40
1927	P. des Sioux	Mo.	...	...	...	...	...	...	1	9	6	*8*	6	3	...	...	33	...	...	...	...	...	10	*8*	3	5	3	1	...	30
1927	P. des Sioux	Mo.	...	...	...	...	...	...	...	4	9	*6*	6	...	2	...	27	...	...	...	...	...	7	6	*10*	4	1	...	...	28
1924	Louisiana	Mo.	...	...	...	...	...	1	2	*12*	9	2	...	...	...	...	26	...	...	...	...	2	8	*9*	7	1	...	...	...	27
1928	Rich-Tex.	S. C.	...	...	...	...	...	...	...	...	...	...	1	...	...	...	1	...	...	...	...	...	...	...	...	...	1	...	...	1
1928	Eastover	S. C.	...	...	...	...	...	...	1	1	7	*6*	...	4	1	...	20	...	...	...	...	...	3	5	*3*	3	5	...	1	20

* The figures in italics are the class containing the median or mid value.

TABLE I (Continued)

IRIS VIRGINICA (Continued)

Year	Town	State	Individuals of each colony classified according to size																												
			Petal length in centimeters															Total number	Sepal length in centimeters												Total Number
			1.9–2.2	2.3–2.6	2.7–3.0	3.1–3.4	3.5–3.8	3.9–4.2	4.3–4.6	4.7–5.0	5.1–5.4	5.5–5.8	5.9–6.2	6.3–6.6	6.7–7.0	7.1–7.4		3.7–4.0	4.1–4.4	4.5–4.8	4.9–5.2	5.3–5.6	5.7–6.0	6.1–6.4	6.5–6.8	6.9–7.2	7.3–7.6	7.7–8.0	8.1–8.4		
1928	Fair Bluff	N. C.									1	3	1				5							*3*	2					5
1928	Wilmington	N. C.							1			2	*7*	4	2	2	18						1	0	3	4	*6*	2	1	17
1928	Maysville	N. C.								2	2	2	*7*	1	1		15								6	1	*5*	3		15
1928	Wolf Creek	Tenn.										1					1									1				1
1924	Fort Madison	Iowa					2	2	*9*	7	4	1	1				26				4	5	*7*	5	5					26
1924	Burk	Iowa							4	2	2						8					2	3	2	1					8
1924	Gilbertville	Iowa						1		4	1	4					10					1	3	5	1					10
1927	Sunbury	Ohio						1	3	5	*7*	10	5				31						5	8	*5*	10	2			30
1925	Mill Creek	Ohio				3	9	*7*	5	3		1					28	1	2	7	*5*	7	3	2	1					28
1925	Huron	Ohio				2	3	*8*	3	5	2						23			3	3	*6*	4	2	4	1				23
1925	Bay Bridge	Ohio				4	16	*24*	14	4							62		4	11	*21*	16	10	1						63
1925	Catawba	Ohio			2	6	18	*17*	13		1						57	2	5	13	*17*	14	6	1						58
1925	S. Mid. Bass Is.	Ohio			1	3	3	*10*	1								18	2	1	3	3	*10*								19
1925	N. Mid. Bass Is.	Ohio				1	3	10	*11*	3	3	1					32	1	1	4	*12*	9	4	1	1	1				34
1925	North Bass Is.	Ohio			1	1	3	4	*11*	2							22	1	3	2	*6*	6	5							23
1924	Newport	Mich.					2	3	*4*	5	1						15				3	4	*3*	4	1					15
1924	Monroe	Mich.						1	4	6	1	1					13					3	6	3	1					13
1924	Brooklyn	Mich.				1	1	7	*8*	3	1		1				22		1	1	7	*7*	3	2		1				22
1926	Lawrence	Mich.						3	5	*12*	10	4	1				35				2	7	*8*	8	4	1				30
1926	Colon	Mich.						1	*9*	*6*	2	1	1				20				1	6	*8*	2	1	1	1			20
1926	Centerville	Mich.						2	4	8	*9*	7					30					4	9	*18*	4					30
1926	Schoolcraft	Mich.							10	*10*	5	4	1				30				2	4	*6*	9	6	2	1			30
1926	Hartland	Mich.						3	9	*14*	8	1					35				3	7	*16*	6	3					35
1924	Armada	Mich.					2	*12*	8	3							25			2	3	*10*	8	2						25
1924	Yale	Mich.					2	10	*18*	12	3	1					46		2	2	9	*12*	12	5	3					45

TABLE I (Continued)

IRIS VIRGINICA (Continued)

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			Petal length in centimeters														Total number	Sepal length in centimeters												Total Number
			1.9–2.2	2.3–2.6	2.7–3.0	3.1–3.4	3.5–3.8	3.9–4.2	4.3–4.6	4.7–5.0	5.1–5.4	5.5–5.8	5.9–6.2	6.3–6.6	6.7–7.0	7.1–7.4		3.7–4.0	4.1–4.4	4.5–4.8	4.9–5.2	5.3–5.6	5.7–6.0	6.1–6.4	6.5–6.8	6.9–7.2	7.3–7.6	7.7–8.0	8.1–8.4	
1924	Otisville	Mich.	...	...	...	2	6	9	*13*	8	3	1	...	...	...	...	42	...	1	3	4	*20*	7	7	1	...	...	...	...	43
1926	Otisville	Mich.	...	...	...	...	...	5	*8*	3	3	...	...	...	...	...	19	...	...	1	4	*5*	9	...	...	...	...	...	...	19
1924	Fay Bridge	Mich.	...	...	...	1	1	6	...	3	2	...	...	...	...	...	13	...	...	2	5	2	3	1	...	...	...	...	...	13
1926	Frankenmuth	Mich.	...	...	...	...	...	4	11	*10*	7	3	...	...	...	...	35	...	...	3	2	9	*7*	6	6	2	...	...	...	35
1927	Frankenmuth	Mich.	...	...	...	...	...	1	8	*11*	7	3	...	...	...	...	30	...	...	...	2	10	*10*	2	4	2	...	...	...	30
1926	W. Saginaw	Mich.	...	...	...	...	...	1	2	*10*	3	...	...	...	...	...	16	...	...	...	2	2	*7*	2	3	...	...	...	...	16
1926	Linwood	Mich.	...	...	...	...	...	2	8	*15*	5	...	...	...	...	...	30	...	...	...	2	7	*8*	5	7	1	...	...	...	30
1927	Linwood	Mich.	...	...	...	...	1	2	5	*15*	1	1	...	...	...	...	25	...	...	1	3	4	*10*	4	1	1	...	1	...	25
1924	Muskegon	Mich.	...	...	...	2	5	10	*14*	10	2	1	...	...	...	...	44	...	2	1	3	*7*	11	1	...	...	...	...	...	25
1924	Albert Lea	Minn.	...	...	...	...	...	2	2	...	...	...	...	...	...	...	4	...	...	1	3	...	...	...	...	...	...	...	...	4
1924	Hayward	Minn.	...	...	...	...	...	1	6	2	1	...	...	...	...	...	10	...	...	...	2	3	3	2	...	...	...	...	...	10
1924	La Crosse	Wis.	...	...	...	1	...	8	14	*15*	9	4	1	...	...	...	52	...	1	1	3	*11*	*18*	12	2	3	...	1	...	52
1927	Pardeeville	Wis.	...	...	...	...	...	6	4	*10*	5	2	...	...	...	...	27	...	...	1	6	*10*	5	1	4	...	...	...	...	27
1924	Slinger	Wis.	...	...	...	...	1	6	7	*13*	5	1	...	...	...	...	33	...	...	3	2	5	*11*	9	2	1	...	...	...	33
1925	Pelee Is.	Ont.	...	...	...	...	...	1	1	1	...	...	...	...	...	...	3	...	...	...	1	1	2	...	1	...	...	...	...	5
1927	Kettle Point	Ont.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...

TABLE I (Continued)

IRIS VERSICOLOR

Year	Town	State	Individuals of each colony classified according to size																														Total Number
			Petal length in centimeters														Total number	Sepal length in centimeters																
			1.9 – 2.2	2.3 – 2.6	2.7 – 3.0	3.1 – 3.4	3.5 – 3.8	3.9 – 4.2	4.3 – 4.6	4.7 – 5.0	5.1 – 5.4	5.5 – 5.8	5.9 – 6.2	6.3 – 6.6	6.7 – 7.0	7.1 – 7.4		3.7 – 4.0	4.1 – 4.4	4.5 – 4.8	4.9 – 5.2	5.3 – 5.6	5.7 – 6.0	6.1 – 6.4	6.5 – 6.8	6.9 – 7.2	7.3 – 7.6	7.7 – 8.0	8.1 – 8.4		
1927	Hood	Md.	...	...	3	6	*9*	7	1	...	...	...	...	...	...	...	26	...	...	...	4	8	*9*	6	...	...	...	...	...	27
1927	Liverpool	Pa.	...	...	...	4	3	*8*	5	...	...	...	...	...	...	...	20	...	...	...	2	3	*9*	4	4	...	...	...	...	22
1925	Harmonsburg	Pa.	...	3	3	*20*	9	8	...	...	...	...	...	...	...	...	43	2	1	2	12	*7*	6	5	...	...	...	...	...	35
1925	Meadville	Pa.	...	...	3	3	7	1	...	...	...	...	...	...	...	...	14	...	1	3	*7*	3	...	...	...	...	...	...	...	14
1925	Greenville	Pa.	1	...	2	4	4	1	1	...	...	...	...	...	...	...	13	...	1	4	2	...	1	...	...	...	...	...	...	8
1924	Conewango	N. Y.	...	...	...	1	3	*14*	4	6	1	...	...	...	...	...	29	...	...	...	3	8	*8*	9	1	...	...	...	...	29
1925	Conewango	N. Y.	...	1	4	*4*	4	3	...	...	...	...	...	...	...	...	16	...	2	3	*9*	2	...	...	...	...	...	...	...	16
1925	Cherry Cr.	N. Y.	...	...	1	4	*10*	3	...	...	...	...	...	...	...	...	18	...	3	6	*7*	3	...	...	...	...	...	...	...	19
1927	Villenova	N. Y.	...	...	...	...	7	*8*	8	2	...	...	...	...	...	...	25	...	...	...	4	9	*9*	4	1	1	...	...	...	28
1925	Hubbardsville	N. Y.	...	...	1	*17*	14	3	...	...	...	...	...	...	...	...	35	...	...	3	4	*14*	12	1	1	...	...	...	...	35
1925	Pownal	Vt.	...	1	12	*10*	3	1	...	...	...	...	...	...	...	...	27	1	3	7	*8*	7	1	...	...	...	...	...	...	27
1925	Pownal Center	Vt.	1	...	12	*19*	5	...	...	...	...	...	...	...	...	...	37	2	4	8	*17*	7	...	...	...	...	...	...	...	38
1925	Clarendon	Vt.	...	2	6	*15*	9	4	1	...	...	...	...	...	...	...	37	2	1	8	*13*	9	4	...	...	...	...	...	...	37
1926	Middlebury	Vt.	...	...	...	2	7	*7*	9	1	...	...	...	...	...	...	26	...	...	2	1	3	*11*	4	4	...	...	...	...	25
1926	New Haven Jc.	Vt.	...	...	1	5	9	*14*	3	2	...	...	...	...	...	...	34	...	...	...	5	11	*11*	4	3	...	...	...	...	34
1924	Holderness	N. H.	...	...	...	1	3	1	...	...	...	...	...	...	...	...	5	...	...	1	1	2	1	...	...	...	...	...	...	5
1927	Duxbury	Mass.	...	...	...	3	*11*	5	1	...	...	...	...	...	...	...	20	...	...	2	4	*10*	3	...	1	...	...	...	...	20
1927	Alberton	Ont.	...	...	...	3	7	*12*	3	...	...	...	...	...	...	...	25	...	...	1	5	*10*	10	...	...	...	...	...	...	26
1926	Ottawa	Ont.	...	...	...	3	7	*8*	10	2	1	...	...	...	...	...	31	...	...	...	1	6	*11*	6	8	...	...	...	...	32
1926	L. Timagami	Ont.	...	...	...	3	7	*5*	9	1	1	...	...	...	...	...	26	...	...	...	2	5	*8*	5	5	1	...	...	...	26
1927	Truro	N. S.	...	...	...	...	6	*9*	3	6	...	...	...	...	...	...	24	...	...	...	1	4	5	*7*	3	2	...	...	...	22
1927	Antigonish	N. S.	...	...	1	5	6	1	...	...	...	...	...	...	...	...	13	...	1	2	5	2	3	1	...	...	...	...	...	14
1927	Baddeck	N. S.	...	...	...	...	3	9	2	...	...	...	...	...	...	...	14	...	...	1	4	2	5	2	...	...	...	...	...	14
1927	McAdam	N. B.	...	...	...	2	2	7	2	...	...	...	...	...	...	...	13	...	...	...	...	6	4	2	1	...	...	...	...	13

TABLE I (Continued)

IRIS VERSICOLOR × I. VIRGINICA

Year	Town	State	Individuals of each colony classified according to size																												
			Petal length in centimeters															Total number	Sepal length in centimeters												Total number
			1.9–2.2	2.3–2.6	2.7–3.0	3.1–3.4	3.5–3.8	3.9–4.2	4.3–4.6	4.7–5.0	5.1–5.4	5.5–5.8	5.9–6.2	6.3–6.6	6.7–7.0	7.1–7.4			3.7–4.0	4.1–4.4	4.5–4.8	4.9–5.2	5.3–5.6	5.7–6.0	6.1–6.4	6.5–6.8	6.9–7.2	7.3–7.6	7.7–8.0	8.1–8.4	
1927	Tawas City	Mich.	...	...	...	6	3	1	1	...	...	...	...	...	...	...	11	...	...	1	5	3	1	1	...	...	...	...	...	11
1927	E. Tawas	Mich.	...	...	...	...	...	...	4	2	3	1	1	...	...	...	11	...	...	1	2	...	3	1	3	1	...	...	...	11
1927	W. St. Ignace	Mich.	...	...	...	1	3	6	*13*	6	3	3	...	...	...	...	35	...	...	...	3	5	8	*9*	5	3	3	...	...	36
1927	Engadine	Mich.	...	...	...	1	3	*10*	6	4	3	...	...	...	...	...	27	...	...	...	1	1	5	*10*	5	4	1	...	...	27
1924	W. Yale	Mich.	...	...	...	3	5	4	2	...	...	...	...	...	...	...	14	...	2	1	6	5	6	2	...	...	...	...	...	22
1927	London	Ont.	...	...	...	...	...	...	6	11	5	1	...	...	...	...	23	...	...	...	1	3	6	*10*	2	...	...	...	...	22

TABLE II

IRIS VIRGINICA

Year	Town	State	Individuals of each colony classified according to size																																			
			Petal width in centimeters														Total number	Sepal width in centimeters																					Total number
			.5–.6	.7–.8	.9–1.0	1.1–1.2	1.3–1.4	1.5–1.6	1.7–1.8	1.9–2.0	2.1–2.2	2.3–2.4	2.5–2.6	2.7–2.8	2.9–3.0			1.3–1.4	1.5–1.6	1.7–1.8	1.9–2.0	2.1–2.2	2.3–2.4	2.5–2.6	2.7–2.8	2.9–3.0	3.1–3.2	3.3–3.4	3.5–3.6	3.7–3.8	3.9–4.0	4.1–4.2		
1927	Kimborough	Ala.	...	...	...	...	1	3	*11**	5	1	2	2	...	...	25	...	...	...	...	2	3	7	*4*	2	5	2	...	...	...	...	25
1927	Wiggins	Miss.	...	...	2	1	3	...	2	2	1	1	...	...	...	12	...	...	...	2	1	2	1	4	..	1	1	...	...	...	...	12
1927	Jackson	Miss.	...	...	...	...	3	4	*8*	4	2	...	...	...	...	21	...	...	...	1	2	5	*8*	5	3	1	1	...	...	...	...	21
1926	Arlington	Tenn.	...	...	...	1	1	6	*7*	2	...	...	...	...	...	17	...	...	...	...	...	2	3	*10*	...	2	...	...	...	...	...	17
1926	Huntingdon	Tenn.	...	...	...	...	1	3	1	1	1	...	...	...	...	7	...	...	...	...	2	...	1	...	4	...	...	...	...	...	...	7
1926	Camden	Tenn.	...	...	...	...	1	3	12	*11*	9	11	3	...	...	50	...	...	...	...	1	0	6	12	*14*	9	5	1	2	...	...	50
1926	Bonnieville	Ky.	...	...	...	...	2	3	*14*	11	4	1	...	...	...	35	...	...	...	...	...	...	3	6	*12*	9	4	1	...	...	...	35
1926	Elizabethtown	Ky.	...	...	...	1	1	...	3	2	2	1	1	...	...	11	...	...	...	...	...	1	1	1	2	1	3	1	...	...	...	10
1926	Stanton	Ky.	...	...	1	...	4	*11*	1	2	2	...	...	...	...	21	...	...	...	1	4	5	*4*	3	2	2	...	...	...	...	...	21
1926	Hayden	Ind.	...	...	1	3	*5*	3	3	2	...	...	...	...	...	17	...	...	2	5	*2*	4	...	3	1	...	...	...	...	...	...	17
1926	Anna	Ill.	...	...	...	...	5	3	*18*	7	2	2	1	...	...	38	...	...	...	...	2	4	7	*10*	8	5	...	2	...	...	...	38
1925	Vulcan	Ill.	...	...	...	...	...	8	*7*	9	1	...	...	...	...	25	...	...	...	1	3	6	*6*	5	5	1	...	...	...	...	...	27
1926	Vulcan	Ill.	...	...	...	1	4	*5*	4	1	...	...	...	...	...	15	...	...	...	...	...	4	*4*	4	3	...	...	...	...	...	...	15
1924	E. St. Louis	Ill.	...	...	...	...	3	5	*8*	2	2	...	2	...	...	22	...	...	...	2	3	3	3	2	3	2	3	...	...	...	...	21
1925	Farmington	Ark.	...	...	...	...	1	1	4	7	*9*	11	3	2	...	38	...	...	...	1	2	2	6	4	*10*	5	1	2	4	1	...	38
1926	Pilot Knob	Mo.	...	...	...	...	...	1	...	4	1	2	...	...	...	8	...	...	...	...	...	...	...	1	3	1	2	1	...	...	...	8
1925	Wicks	Mo.	...	...	...	9	11	*9*	8	4	1	...	...	1	...	43	...	...	1	3	7	7	*10*	9	4	1	1	...	...	...	...	43
1926	Valley Park	Mo.	...	...	...	3	3	2	*7*	5	3	...	...	...	...	23	...	...	1	1	3	2	2	*3*	3	6	2	...	...	...	...	23
1925	P. des Sioux	Mo.	...	...	...	3	1	1	...	...	...	...	...	...	...	5	...	...	...	...	...	...	1	2	...	1	...	1	...	...	...	5
1926	P. des Sioux	Mo.	...	...	2	5	12	*9*	4	4	2	2	...	...	...	40	...	...	...	2	4	5	5	*13*	5	1	2	2	...	...	1	40
1927	P. des Sioux	Mo.	...	...	...	1	6	6	*5*	4	3	1	1	...	1	28	...	...	...	...	1	1	4	5	*6*	5	1	4	...	1	...	28
1928	P. des Sioux	Mo.	...	...	...	1	...	2	7	*6*	4	2	3	1	1	27	...	...	...	...	...	1	1	1	9	*4*	7	2	2	1	...	28
1924	Louisiana	Mo.	...	...	1	...	8	*3*	7	6	1	...	...	...	...	26	...	...	...	1	...	1	6	*7*	7	3	2	...	...	...	...	27
1928	Rich-Tex.	S. C.	...	...	...	...	...	1	...	...	...	...	...	...	...	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	1
1928	Eastover	S. C.	...	...	1	...	1	...	*8*	*8*	2	...	...	...	...	20	...	...	...	1	1	1	6	*3*	6	1	1	...	...	...	...	20
1928	Fair Bluff	N. C.	...	...	...	1	2	1	1	...	...	...	...	...	...	5	...	...	...	...	1	...	1	2	1	...	...	...	...	...	...	...	5

* The figures in italics are the class containing the median or mid-value.

TABLE II (Continued)

IRIS VIRGINICA (Continued)

Year	Town	State	Individuals of each colony classified according to size: Petal width in centimeters .5–.6	.7–.8	.9–1.0	1.1–1.2	1.3–1.4	1.5–1.6	1.7–1.8	1.9–2.0	2.1–2.2	2.3–2.4	2.5–2.6	2.7–2.8	2.9–3.0	Total number	Sepal width in centimeters 1.3–1.4	1.5–1.6	1.7–1.8	1.9–2.0	2.1–2.2	2.3–2.4	2.5–2.6	2.7–2.8	2.9–3.0	3.1–3.2	3.3–3.4	3.5–3.6	3.7–3.8	3.9–4.0	4.1–4.2	Total number
1928	Wilmington	N. C.	...	...	...	...	1	2	5	*4*	4	1	...	...	...	17	...	...	...	...	1	...	3	3	*6*	1	1	1	...	1	...	17
1928	Maysville	N. C.	...	...	...	...	...	1	6	*3*	2	2	1	...	...	15	...	...	...	...	...	...	1	4	*6*	2	2	...	...	...	...	15
1928	Wolf Creek	Tenn.	...	...	...	...	...	...	1	...	...	...	...	...	...	1	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	1
1924	Fort Madison	Iowa	...	...	...	1	6	*7*	8	1	3	...	...	...	...	26	...	...	...	1	3	*5*	3	*5*	4	1	3	...	...	1	...	26
1924	Burk	Iowa	...	...	...	...	...	2	4	1	1	...	...	...	...	8	...	...	...	...	1	1	...	3	1	1	1	...	...	...	...	8
1924	Gilbertville	Iowa	...	...	...	...	5	1	1	...	2	...	...	...	...	9	...	...	...	...	...	4	2	1	2	...	1	...	...	...	...	10
1927	Sunbury	Ohio	...	...	...	1	3	1	*10*	*11*	3	...	1	...	...	30	...	...	...	...	1	2	6	4	*7*	4	4	1	1	...	...	30
1925	Mill Creek	Ohio	...	...	8	3	*6*	3	4	2	...	...	...	...	...	26	...	2	7	*5*	*4*	4	3	2	1	...	...	...	...	...	...	28
1925	Huron	Ohio	...	1	3	1	*11*	5	...	1	1	...	...	...	...	23	...	...	...	6	1	*5*	6	3	2	...	...	...	...	...	...	23
1925	Bay Bridge	Ohio	...	1	9	16	*17*	5	9	3	...	...	...	...	...	60	...	...	2	11	13	*16*	15	2	1	1	1	...	...	...	...	62
1925	Catawba	Ohio	...	1	5	18	*13*	9	6	4	1	...	...	...	...	57	...	...	2	9	12	*12*	10	6	4	3	...	...	...	...	...	58
1925	S. Mid. Bass Is.	Ohio	...	3	1	*6*	7	1	1	...	...	...	...	...	...	19	...	...	1	...	6	*3*	6	2	1	...	...	...	...	...	...	19
1925	N. Mid. Bass Is.	Ohio	...	...	1	3	7	*14*	5	1	...	...	...	...	...	31	...	...	...	1	9	5	*8*	4	4	...	...	1	...	...	...	32
1925	N. Bass Is.	Ohio	...	...	3	5	*7*	3	2	...	...	...	...	...	...	20	...	1	...	2	3	*5*	9	...	2	...	...	...	...	...	...	22
1924	Newport	Mich.	...	...	...	1	2	*6*	3	1	1	1	...	...	...	15	...	...	...	...	2	2	3	*4*	3	...	1	...	...	...	...	15
1924	Monroe	Mich.	...	...	...	...	6	1	4	1	1	...	...	...	...	13	...	...	1	...	3	3	2	2	...	...	2	...	...	...	...	13
1924	Brooklyn	Mich.	...	...	...	2	7	*5*	4	1	2	1	...	...	...	22	...	...	...	1	2	4	*4*	*6*	2	3	...	...	...	...	...	22
1926	Lawrence	Mich.	...	...	...	...	1	9	6	*13*	4	1	1	...	...	35	...	...	...	2	1	4	8	*8*	8	2	2	...	...	...	...	35
1926	Colon	Mich.	...	...	...	2	4	8	5	1	...	...	...	...	...	20	...	...	...	...	3	5	*5*	4	1	2	...	...	...	...	...	20
1926	Centerville	Mich.	...	...	...	2	3	9	*10*	3	1	2	...	...	...	30	...	...	...	...	...	2	8	*7*	8	3	...	2	...	...	...	30
1926	Schoolcraft	Mich.	...	...	3	...	2	6	*11*	6	2	...	...	...	...	30	...	...	...	1	4	5	*6*	6	6	2	...	...	...	...	...	30
1926	Hartland	Mich.	...	...	...	1	2	7	*10*	8	4	3	...	...	...	35	...	...	...	1	3	7	5	*10*	6	1	1	1	...	...	...	35
1924	Armada	Mich.	...	...	...	3	*11*	5	6	1	...	...	...	...	...	26	...	...	...	3	*10*	4	6	1	1	...	...	...	...	...	...	25
1924	Yale	Mich.	...	...	...	1	9	*12*	*12*	7	2	1	...	...	...	44	...	...	1	5	13	*12*	6	4	2	2	...	...	...	...	...	45
1924	Otisville	Mich.	...	...	1	3	15	*11*	10	1	1	...	...	...	...	42	...	...	2	6	12	*9*	9	4	1	...	...	...	...	...	...	43
1926	Otisville	Mich.	...	...	...	...	2	6	*6*	5	2	...	...	...	...	21	...	...	...	2	5	*5*	5	4	...	...	...	...	...	...	...	21
1924	Fay Bridge	Mich.	...	...	...	1	5	2	2	2	...	...	...	...	...	12	...	...	...	...	4	6	3	...	...	...	...	...	...	...	...	13

TABLE II (Continued)

IRIS VIRGINICA (Continued)

Year	Town	State	Individuals of each colony classified according to size																																		
			Petal width in centimeters														Total number	Sepal width in centimeters																				Total number
			.5–.6	.7–.8	.9–1.0	1.1–1.2	1.3–1.4	1.5–1.6	1.7–1.8	1.9–2.0	2.1–2.2	2.3–2.4	2.5–2.6	2.7–2.8	2.9–3.0			1.3–1.4	1.5–1.6	1.7–1.8	1.9–2.0	2.1–2.2	2.3–2.4	2.5–2.6	2.7–2.8	2.9–3.0	3.1–3.2	3.3–3.4	3.5–3.6	3.7–3.8	3.9–4.0	4.1–4.2							
1926	Frankenmuth	Mich.	...	...	...	3	2	4	*14*	9	1	1	...	1	...		35	...	...	...	3	2	9	*6*	8	3	2	2	...	...	...	...					35
1927	Frankenmuth	Mich.	...	...	...	1	2	8	*10*	6	2	1	...	...	...		30	...	1	...	2	1	3	6	*8*	7	2	...	...	...	...	...					30
1926	W. Saginaw	Mich.	...	...	...	...	...	1	4	*7*	3	1	...	...	...		16	...	...	...	...	1	3	3	*3*	4	2	...	...	...	...	...					16
1926	Linwood	Mich.	...	...	...	1	3	3	*8*	*9*	5	1	...	...	...		30	...	...	...	1	1	2	5	*6*	*7*	5	2	1	...	...	...					30
1927	Linwood	Mich.	...	...	...	1	2	8	*3*	5	2	4	...	...	...		25	...	...	...	1	1	2	2	6	*3*	4	3	2	1	...	...					25
1924	Muskegon	Mich.	...	...	...	2	9	*16*	8	4	2	3	...	...	...		44	...	4	...	4	11	*10*	4	6	2	1	1	...	...	...	...					43
1924	Albert Lea	Minn.	...	...	...	...	...	3	1	...	...	...	...	...	...		4	...	...	...	1	2	1	...	...	...	...	...	...	...	...	...					4
1924	Hayward	Minn.	...	...	...	1	4	3	1	...	...	...	...	...	...		9	...	...	1	...	4	4	...	1	...	...	...	...	...	...	...					10
1924	La Crosse	Wis.	...	...	...	7	7	*16*	11	6	4	1	...	...	...		52	...	...	...	...	1	11	*15*	8	6	9	2	...	...	...	...					52
1927	Pardeeville	Wis.	...	...	...	...	...	7	*10*	6	4	...	...	...	...		27	...	...	...	...	2	6	3	*5*	7	1	3	...	...	...	...					27
1924	Slinger	Wis.	...	...	...	2	2	9	*18*	2	4	2	...	...	...		33	...	...	...	2	7	*10*	3	6	4	1	...	...	...	...	...					33
1925	Pelee Is.	Ont.	...	...	...	...	1	1	...	2	...	...	...	...	...		4	...	...	...	...	...	...	1	1	2	...	...	...	...	...	...					4
1927	Kettle Point	Ont.	...	...	...	...	...	...	...	...	...	...	...	...	...		...	...	...	...	...	...	1	...	...	1	1	...	...	...	...	...					3

TABLE II (Continued)

IRIS VERSICOLOR

Year	Town	State	Individuals of each colony classified according to size																																	
			Petal width in centimeters														Total number	Sepal width in centimeters																			Total number
			.5–.6	.7–.8	.9–1.0	1.1–1.2	1.3–1.4	1.5–1.6	1.7–1.8	1.9–2.0	2.1–2.2	2.3–2.4	2.5–2.6	2.7–2.8	2.9–3.0			1.3–1.4	1.5–1.6	1.7–1.8	1.9–2.0	2.1–2.2	2.3–2.4	2.5–2.6	2.7–2.8	2.9–3.0	3.1–3.2	3.3–3.4	3.5–3.6	3.7–3.8	3.9–4.0	4.1–4.2						
1927	Hood	Md.	1	3	8	*6*	5	2	1	...	...	...	...	...	...	26	...	...	...	1	2	5	4	*10*	3	1	1	...	...	...	...	27
1927	Liverpool	Pa.	...	1	3	3	*5*	6	1	1	...	...	...	...	...	20	...	...	...	...	1	...	1	6	*4*	6	3	...	1	...	...	22
1925	Harmonsburg	Pa.	...	6	4	*12*	8	3	...	...	...	...	...	...	...	33	...	...	...	2	1	3	10	*11*	6	1	...	...	...	...	...	34
1925	Meadville	Pa.	...	9	4	1	...	...	...	...	...	...	...	...	...	14	...	...	1	...	4	3	4	1	...	...	...	...	...	...	...	13
1925	Greenville	Pa.	...	3	7	1	...	...	...	...	...	...	...	...	...	11	...	...	1	1	3	2	2	3	...	1	...	...	...	...	...	13
1924	Conewango	N. Y.	...	...	...	2	4	6	*6*	9	2	...	...	...	...	29	...	...	...	...	1	...	1	1	6	*10*	7	3	...	...	...	29
1925	Conewango	N. Y.	...	2	5	*4*	4	1	...	...	...	...	...	...	...	16	...	...	...	1	2	2	*6*	3	1	...	...	...	...	...	...	15
1925	Cherry Cr.	N. Y.	...	3	5	*5*	2	3	...	...	...	...	...	...	...	18	...	...	...	1	1	3	*8*	3	2	1	...	...	...	...	...	19
1927	Villenova	N. Y.	...	...	...	...	6	*9*	9	2	...	...	...	...	...	26	...	...	...	...	...	2	4	6	*10*	2	1	...	...	1	...	26
1925	Hubbardsville	N. Y.	...	5	*13*	10	5	1	...	...	...	...	...	...	...	34	...	...	...	1	5	4	*8*	3	10	2	2	...	...	...	...	35
1925	Pownal	Vt.	1	10	*11*	2	2	...	...	...	...	...	...	...	...	26	...	...	2	6	*7*	8	3	1	...	...	...	...	...	...	...	27
1925	Pownal Cent.	Vt.	...	11	*8*	*11*	7	...	1	...	...	...	...	...	...	38	...	...	3	7	4	*11*	6	5	1	...	...	...	...	...	...	37
1925	Clarendon	Vt.	...	4	*15*	13	3	1	...	...	...	...	...	...	...	36	...	...	1	1	4	12	*8*	8	3	...	...	...	...	...	...	37
1926	Middlebury	Vt.	...	...	...	4	*10*	5	4	2	...	...	...	...	...	25	...	...	...	...	...	1	3	3	4	*8*	3	1	2	...	...	25
1926	New Haven Jct.	Vt.	...	...	3	5	*9*	*8*	6	2	1	...	...	...	...	34	...	...	...	...	...	1	2	4	5	*8*	8	4	2	...	...	34
1924	Holderness	N. H.	...	1	2	2	...	...	...	...	...	...	...	...	...	5	...	...	...	...	1	1	...	1	1	...	...	...	...	...	...	5
1927	Duxbury	Mass.	...	...	1	8	7	1	...	2	...	1	...	...	...	20	...	...	...	...	...	1	...	3	*8*	3	3	1	1	...	...	20
1927	Alberton	Ont.	...	...	...	1	5	*8*	9	1	1	...	...	...	...	25	...	...	...	...	...	...	2	1	7	*5*	6	3	1	1	...	26
1926	Ottawa	Ont.	...	...	3	10	*7*	7	3	...	...	1	...	...	...	31	...	...	...	...	...	...	3	6	5	*6*	4	3	2	3	...	32
1926	L. Timagami	Ont.	...	...	4	*10*	9	2	1	...	...	...	...	...	...	26	...	...	...	...	...	...	...	2	3	5	*10*	3	2	1	...	26
1927	Truro	N. S.	...	...	1	4	*10*	5	...	3	...	...	...	...	...	23	...	...	...	...	...	...	1	4	*9*	3	2	3	1	...	...	23
1927	Antigonish	N. S.	...	...	...	2	6	4	1	...	...	...	...	...	...	13	...	...	...	...	...	...	...	4	1	4	3	2	...	...	...	14
1927	Baddeck	N. S.	...	...	...	7	1	2	4	1	...	...	...	...	...	15	...	...	...	...	...	...	2	4	3	5	...	...	...	...	...	14
1927	McAdam	N. B.	...	...	1	1	2	3	3	1	1	...	...	...	...	12	...	...	...	...	...	...	1	...	2	5	2	...	1	1	...	...	12

TABLE II (Continued)

IRIS VERSICOLOR × I. VIRGINICA

Year	Town	State	Individuals of each colony classified according to size																														
			Petal width in centimeters														Total number	Sepal width in centimeters																Total number
			.5–.6	.7–.8	.9–1.0	1.1–1.2	1.3–1.4	1.5–1.6	1.7–1.8	1.9–2.0	2.1–2.2	2.3–2.4	2.5–2.6	2.7–2.8	2.9–3.0			1.3–1.4	1.5–1.6	1.7–1.8	1.9–2.0	2.1–2.2	2.3–2.4	2.5–2.6	2.7–2.8	2.9–3.0	3.1–3.2	3.3–3.4	3.5–3.6	3.7–3.8	3.9–4.0	4.1–4.2		
1927	Tawas City	Mich.	...	...	...	6	2	1	2	...	...	...	...	...	...	11	...	...	...	...	...	2	4	2	3	...	...	...	...	...	...	11
1927	E. Tawas	Mich.	...	...	...	...	...	3	2	6	...	...	...	...	...	11	...	...	...	1	...	2	3	2	3	...	...	...	...	...	...	11
1924	W. St. Ignace	Mich.	...	...	3	4	*11*	8	4	4	1	...	...	...	...	35	...	...	...	2	3	2	6	*5*	8	6	1	1	1	...	...	35
1927	Engadine	Mich.	...	...	...	4	5	*8*	5	3	1	1	...	...	...	27	...	...	...	...	...	...	1	3	3	*8*	4	3	5	...	...	27
1927	W. Yale	Mich.	...	1	5	1	6	1	...	...	...	...	...	...	...	14	...	...	...	...	3	3	*4*	2	1	...	2	...	...	...	...	15
1927	London	Ont.	...	...	...	...	...	3	*9*	10	1	...	...	...	...	23	...	...	...	...	...	3	4	*5*	4	6	1	...	...	...	...	23

TABLE III

IRIS VIRGINICA

Year	Town	State	Individuals of each colony classified according to size																											
			Petal taper in centimeters													Total number	Sepal taper in centimeters													Total number
			.6–.7	.8–.9	1.0–1.1	1.2–1.3	1.4–1.5	1.6–1.7	1.8–1.9	2.0–2.1	2.2–2.3	2.4–2.5	2.6–2.7	2.8–2.9			1.0–1.1	1.2–1.3	1.4–1.5	1.6–1.7	1.8–1.9	2.0–2.1	2.2–2.3	2.4–2.5	2.6–2.7	2.8–2.9		
1927	Kimborough	Ala.	...	...	3	4	4	*5**	6	3	...	...	...	...	25		...	1	3	4	*4*	11	2	...	...	...	25	
1927	Wiggins	Miss.	...	...	...	1	1	2	4	3	...	...	1	...	12		...	...	...	...	2	1	4	2	1	1	11	
1927	Jackson	Miss.	...	...	3	5	2	*5*	3	2	1	...	...	...	21		...	2	1	*5*	*4*	3	4	...	1	1	21	
1926	Arlington	Tenn.	...	...	2	...	5	*4*	3	2	1	...	...	...	17		...	...	...	3	5	*3*	2	2	...	2	17	
1926	Huntingdon	Tenn.	...	...	2	...	1	2	1	1	...	...	...	...	7		...	...	1	1	1	...	2	1	1	...	7	
1926	Camden	Tenn.	...	...	3	3	15	*9*	9	7	2	1	1	...	50		...	1	1	5	5	*14*	12	8	3	1	50	
1926	Bonnieville	Ky.	...	1	...	5	5	*10*	4	8	1	1	...	...	35		...	...	2	1	5	8	*9*	9	1	...	35	
1926	Elizabethtown	Ky.	...	...	...	1	5	2	3	...	...	...	...	...	11		...	...	2	...	1	6	1	...	1	...	11	
1926	Stanton	Ky.	...	2	*11*	2	3	2	1	...	...	...	...	...	21		4	3	*7*	5	...	2	...	...	...	...	21	
1926	Hayden	Ind.	...	...	3	3	*7*	2	1	1	...	...	...	...	17		...	4	5	3	3	...	2	...	...	...	17	
1926	Anna	Ill.	...	...	5	8	*14*	6	3	...	1	...	...	...	37		...	...	2	5	11	*15*	3	2	...	...	38	
1925	Vulcan	Ill.	...	...	...	...	...	...	...	...	...	...	...	...	—		...	...	...	...	...	...	...	...	...	...	—	
1926	Vulcan	Ill.	...	...	1	3	*6*	3	1	1	...	...	...	...	15		...	1	2	*7*	2	3	...	...	...	...	15	
1924	E. St. Louis	Ill.	...	...	...	...	...	...	...	...	...	...	...	...	—		...	...	...	...	...	...	...	...	...	...	—	
1925	Farmington	Ark.	...	...	...	...	...	...	...	...	...	...	...	...	—		...	...	...	...	...	...	...	...	...	...	—	
1926	Pilot Knob	Mo.	...	...	...	...	1	2	1	1	1	...	...	...	6		...	...	...	1	2	1	2	2	...	...	8	
1925	Wicks	Mo.	...	...	...	...	...	...	...	...	...	...	...	...	—		...	...	...	...	...	...	...	...	...	...	—	
1926	Valley Park	Mo.	...	...	1	5	*5*	*4*	*5*	...	2	...	...	...	22		...	1	1	4	*7*	6	2	...	1	1	23	
1925	P. des Sioux	Mo.	...	...	...	...	...	...	...	...	...	...	...	...	—		...	...	...	...	...	...	...	...	...	...	—	
1926	P. des Sioux	Mo.	...	2	5	*14*	14	1	3	1	...	...	...	...	40		...	1	5	8	*13*	8	3	1	1	...	40	
1927	P. des Sioux	Mo.	...	...	1	4	6	*6*	3	4	1	2	...	1	28		...	...	2	6	*6*	5	4	3	1	...	27	
1924	Louisiana	Mo.	...	...	...	...	...	...	...	...	...	...	...	...	—		...	...	...	...	...	...	...	...	...	...	—	
1924	Fort Madison	Iowa	...	...	...	...	...	...	...	...	...	...	...	...	—		...	...	...	...	...	...	...	...	...	...	—	
1924	Burk	Iowa	...	...	...	...	...	...	...	...	...	...	...	...	—		...	...	...	...	...	...	...	...	...	...	—	

* The figures in italics are the class containing the median or mid value.

TABLE III (Continued)

IRIS VIRGINICA (Continued)

Year	Town	State	Individuals of each colony classified according to size																							
			Petal taper in centimeters													Sepal taper in centimeters										
			.6–.7	.8–.9	1.0–1.1	1.2–1.3	1.4–1.5	1.6–1.7	1.8–1.9	2.0–2.1	2.2–2.3	2.4–2.5	2.6–2.7	2.8–2.9	Total number	1.0–1.1	1.2–1.3	1.4–1.5	1.6–1.7	1.8–1.9	2.0–2.1	2.2–2.3	2.4–2.5	2.6–2.7	2.8–2.9	Total number
1924	Gilbertville	Iowa	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	—
1927	Sunbury	Ohio	...	1	6	*9*	8	6	...	...	...	...	...	...	30	...	2	9	3	*10*	6	...	...	...	...	30
1925	Mill Creek	Ohio	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	—
1925	Huron	Ohio	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	—
1925	Bay Bridge	Ohio	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	—
1925	Catawba	Ohio	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	—
1925	S. Middle Bass Is.	Ohio	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	—
1925	N. Middle Bass Is.	Ohio	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	—
1925	North Bass Is.	Ohio	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	—
1924	Newport	Mich.	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	—
1924	Monroe	Mich.	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	—
1924	Brooklyn	Mich.	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	—
1926	Lawrence	Mich.	...	1	1	12	*10*	8	2	1	...	...	...	...	35	...	3	6	*10*	9	6	1	...	...	...	35
1926	Colon	Mich.	...	3	5	*6*	4	...	2	...	...	...	...	...	20	1	5	*7*	2	2	2	1	...	...	...	20
1926	Centerville	Mich.	1	2	5	*8*	7	5	2	...	...	...	...	...	30	...	3	5	*7*	*12*	2	1	...	...	...	30
1926	Schoolcraft	Mich.	...	1	10	*6*	8	3	1	1	...	...	...	...	30	...	6	8	*7*	5	4	...	...	...	...	30
1926	Hartland	Mich.	...	2	3	10	*14*	5	1	...	...	...	...	...	35	...	5	10	*11*	7	2	...	...	...	...	35
1924	Armada	Mich.	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	—
1924	Yale	Mich.	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	—
1924	Otisville	Mich.	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	—
1926	Otisville	Mich.	...	2	6	*9*	1	3	...	...	...	...	...	...	21	2	5	*7*	4	...	...	...	...	...	...	18
1924	Fay Bridge	Mich.	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	—
1926	Frankenmuth	Mich.	...	1	7	*12*	8	5	...	2	...	...	...	...	35	2	4	*12*	7	7	3	...	...	...	...	35
1927	Frankenmuth	Mich.	...	2	4	6	*5*	6	4	1	2	...	...	...	30	...	2	11	*10*	7	...	...	...	...	...	30
1926	W. Saginaw	Mich.	...	...	1	5	*5*	4	1	...	...	...	...	...	16	...	1	*8*	2	3	2	...	...	...	...	16

TABLE III (Continued)

IRIS VIRGINICA (Continued)

Year	Town	State	Individuals of each colony classified according to size																							
			Petal taper in centimeters												Total number	Sepal taper in centimeters										Total number
			.6–.7	.8–.9	1.0–1.1	1.2–1.3	1.4–1.5	1.6–1.7	1.8–1.9	2.0–2.1	2.2–2.3	2.4–2.5	2.6–2.7	2.8–2.9		1.0–1.1	1.2–1.3	1.4–1.5	1.6–1.7	1.8–1.9	2.0–2.1	2.2–2.3	2.4–2.5	2.6–2.7	2.8–2.9	
1926	Linwood	Mich.	1	...	3	9	*11*	4	1	...	...	...	...	...	29	...	4	5	*10*	5	3	2	1	...	...	30
1927	Linwood	Mich.	...	...	...	8	*13*	3	...	1	...	...	...	...	25	...	1	2	8	*9*	1	3	1	...	...	25
1924	Muskegon	Mich.	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	—
1924	Albert Lea	Minn.	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	—
1924	Hayward	Minn.	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	—
1924	La Crosse	Wis.	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	—
1927	Pardeeville	Wis.	...	...	6	*13*	4	3	1	...	...	...	...	...	27	...	1	6	*10*	7	3	...	...	...	...	27
1924	Slinger	Wis.	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	—
1925	Pelee Is.	Ont.	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	—
1927	Kettle Point	Ont.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...	...	1	...	...	...	3

TABLE III (Continued)

IRIS VERSICOLOR

Year	Town	State	Individuals of each colony classified according to size																							
			Petal taper in centimeters													Sepal taper in centimeters										
			.6–.7	.8–.9	1.0–1.1	1.2–1.3	1.4–1.5	1.6–1.7	1.8–1.9	2.0–2.1	2.2–2.3	2.4–2.5	2.6–2.7	2.8–2.9	Total number	1.0–1.1	1.2–1.3	1.4–1.5	1.6–1.7	1.8–1.9	2.0–2.1	2.2–2.3	2.4–2.5	2.6–2.7	2.8–2.9	Total number
1927	Hood	Md.	...	7	*13*	5	1	...	...	...	...	...	...	...	26	...	1	3	7	*10*	4	2	...	...	...	27
1927	Liverpool	Pa.	...	...	3	*8*	7	1	1	...	...	...	...	...	20	...	...	...	...	3	7	*9*	2	...	...	21
1925	Harmonsburg	Pa.	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	—
1925	Meadville	Pa.	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	—
1925	Greenville	Pa.	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	—
1924	Conewango	N. Y.	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	—
1925	Conewango	N. Y.	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	—
1925	Cherry Creek	N. Y.	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	—
1927	Villenova	N. Y.	...	...	2	9	*9*	5	1	...	...	...	...	...	26	...	...	...	3	4	*12*	5	2	...	...	26
1925	Hubbardsville	N. Y.	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	—
1925	Pownal	Vt.	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	—
1925	Pownal Cent.	Vt.	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	—
1925	Clarendon	Vt.	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	—
1926	Middlebury	Vt.	...	...	4	*10*	7	4	...	...	...	...	...	...	25	...	...	2	2	2	6	*6*	4	3	...	25
1926	New Haven Jct.	Vt.	...	...	4	*14*	13	2	1	...	...	...	...	...	34	...	...	...	1	13	*6*	7	6	1	...	34
1924	Holderness	N. H.	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	—
1927	Duxbury	Mass.	...	...	4	*11*	2	1	1	1	...	...	...	...	20	...	1	2	3	3	*5*	4	2	...	...	19
1927	Alberton	Ont.	...	...	4	*11*	8	2	...	...	...	...	...	...	25	...	...	2	4	6	*12*	1	1	...	...	26
1926	Ottawa	Ont.	...	1	4	7	*7*	10	2	...	...	...	...	...	31	...	...	1	2	6	*10*	8	3	...	2	32
1926	L. Timagami	Ont.	...	...	3	*11*	9	1	1	1	...	...	...	...	26	...	...	...	4	5	*4*	*6*	5	2	...	26
1927	Truro	N. S.	...	...	...	2	8	*6*	4	4	...	...	...	...	24	...	...	...	3	7	*7*	4	2	...	...	23
1927	Antigonish	N. S.	...	1	3	7	2	...	...	...	...	...	...	...	13	...	...	...	5	4	2	3	...	...	...	14
1927	Baddeck	N. S.	...	...	1	3	7	2	2	...	...	...	...	...	15	1	...	1	3	6	3	...	...	...	...	14
1927	McAdam	N. B.	...	1	2	2	5	2	...	...	...	...	...	...	12	...	...	...	2	4	6	...	...	...	...	12

TABLE III (Continued)

IRIS VERSICOLOR × I. VIRGINICA

Year	Town	State	Individuals of each colony classified according to size																							
			Petal taper in centimeters												Total number	Sepal taper in centimeters										Total number
			.6–.7	.8–.9	1.0–1.1	1.2–1.3	1.4–1.5	1.6–1.7	1.8–1.9	2.0–2.1	2.2–2.3	2.4–2.5	2.6–2.7	2.8–2.9		1.0–1.1	1.2–1.3	1.4–1.5	1.6–1.7	1.8–1.9	2.0–2.1	2.2–2.3	2.4–2.5	2.6–2.7	2.8–2.9	
1927	Tawas City	Mich.	1	2	6	1	1	...	...	...	...	...	...	...	11	...	...	5	2	4	...	...	...	...	...	11
1927	E. Tawas	Mich.	...	...	3	3	3	2	...	...	...	...	...	...	11	...	2	3	3	2	1	...	...	...	...	11
1927	W. St. Ignace	Mich.	...	2	3	8	*15*	5	1	1	...	...	...	...	35	...	1	4	6	7	*10*	4	2	...	1	35
1927	Engadine	Mich.	...	1	3	6	*6*	7	4	...	...	...	...	...	27	...	...	...	1	6	*12*	7	1	...	...	27
1924	W. Yale	Mich.	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	—
1927	London	Ont.	...	...	1	8	*6*	1	4	3	...	...	...	...	23	...	1	4	5	*8*	5	...	...	...	...	23

TABLE IV

IRIS VIRGINICA

Year	Town	State	Individuals of each colony classified according to size																																			
			Anther length in centimeters																Total number	Crest in centimeters																		Total number
			.7	.8	.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1			.7	.8	.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0		
1927	Kimborough	Ala.																																				
1927	Wiggins	Miss.																																				
1927	Jackson	Miss.																																				
1926	Arlington	Tenn.																				3	*6**	3		3	1	1										17
1926	Huntingdon	Tenn.																				2		3	2													7
1926	Camden	Tenn.																			1	2	6	7	*10*	14	7	1		1	1							50
1926	Bonnieville	Ky.																			2	4	5	5	*6*	7	1	3										33
1926	Elizabethtown	Ky.																				2	2	2	1	3	1											11
1926	Stanton	Ky.																		1	1	3	4	*7*	3		1											20
1926	Hayden	Ind.																		1			2	3	*3*	4	3	1										17
1926	Anna	Ill.																			3	2	9	*7*	9	4	1	1	1									37
1925	Vulcan	Ill.							1	2	4	*11*	5		2	1			26				1	3	2	5	*8*	3	3	1		1						27
1926	Vulcan	Ill.																				2	4	*4*	1	3	1											15
1924	E. St. Louis	Ill.																					2	3	*8*	3	4	1	1									22
1925	Farmington	Ark.								2	1	5	10	*8*	4	4	3		37				1	3	4	*11*	*7*	4	3	4		1						38
1926	Pilot Knob	Mo.																						1	5		1	1										8
1925	Wicks	Mo.				3	1	8	*16*	7	5	1	1						42			1	8	6	*7*	11	5	2	2									42
1926	Valley Park	Mo.																			1		2	7	*4*	5	2	1	1									23
1925	P. des Sioux	Mo.						1		3	1	5							10			3	1		1		1											6
1926	P. des Sioux	Mo.																		2		6	11	*11*	6	3												39
1927	P. des Sioux	Mo.																																				
1924	Louisiana	Mo.																					2	2	4	*9*	5	2	1	1								26
1928	Rich-Tex	S. C.																																				
1928	Eastover	S. C.					1	2	4	*4*	1	3	4	1					20			2	1	1	3	3	3	4	2		1							20
1928	Fair Bluff	N. C.					1	1	1	1	1								5			1		3		1												5
1928	Wilmington	N. C.						1		1	3	2	*4*	4			1		16				3	1	1	2	2	5	3									17

*The figures in italics are the class containing the median or mid value.

TABLE IV (Continued)

IRIS VIRGINICA (Continued)

Year	Town	State	Individuals of each colony classified according to size																													
			Anther length in centimeters															Total number	Crest in centimeters													Total number
			.7	.8	.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1		.7	.8	.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	
1928	Maysville	N. C.	...	...	...	...	...	...	1	...	6	4	1	2	1	...	...	15	...	...	...	...	...	1	1	3	3	4	2	1	...	...	15
1928	Wolf Creek	Tenn.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	1
1924	Fort Madison	Iowa	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	4	*10*	8	2	...	...	1	...	...	...	26
1924	Burk	Iowa	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	2	3	1	...	...	...	...	...	...	...	...	8
1924	Gilbertville	Iowa	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...	3	...	3	...	1	...	...	...	9
1927	Sunbury	Ohio	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1925	Mill Creek	Ohio	...	...	...	...	...	6	7	*6*	8	...	1	...	...	...	...	28	3	6	5	*8*	10	4	1	1	...	...	...	...	...	...	38
1925	Huron	Ohio	...	1	1	...	2	2	*9*	6	2	...	...	...	...	...	...	23	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1925	Bay Bridge	Ohio	...	...	...	...	3	17	8	*17*	8	3	2	1	...	...	...	59	8	7	11	*16*	9	7	2	1	...	...	...	...	...	...	61
1925	Catawba	Ohio	...	...	2	2	3	12	*19*	14	4	1	...	...	1	...	...	58	10	12	*8*	17	7	3	...	...	...	...	...	...	...	...	57
1925	S. Mid. Bass Is.	Ohio	...	...	...	1	4	*5*	3	5	...	...	...	...	...	...	...	18	...	...	1	6	*9*	...	1	...	...	...	...	...	...	...	17
1925	N. Mid. Bass Is.	Ohio	...	...	...	...	1	4	7	*11*	6	1	2	...	...	...	...	32	...	2	2	7	*10*	6	3	1	...	...	...	...	...	...	31
1925	North Bass Is.	Ohio	...	...	...	1	...	3	2	*8*	5	2	...	...	...	...	...	21	1	2	3	*5*	4	2	1	...	...	...	...	...	...	...	18
1924	Newport	Mich.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	3	*6*	4	...	1	...	...	...	...	...	...	15
1924	Monroe	Mich.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	4	2	1	3	...	...	...	...	...	...	12
1924	Brooklyn	Mich.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	4	4	*10*	3	...	...	...	...	...	...	...	22
1926	Lawrence	Mich.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	3	9	*12*	6	3	1	...	...	...	...	...	35
1926	Colon	Mich.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	7	*6*	1	4	...	...	...	...	...	...	20
1926	Centerville	Mich.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	1	6	*10*	3	4	1	3	...	...	...	...	30
1926	Schoolcraft	Mich.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	2	7	*7*	4	3	1	2	1	...	...	...	30
1926	Hartland	Mich.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	4	4	6	*11*	7	...	1	...	1	...	35
1924	Armada	Mich.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	2	*16*	5	1	...	...	...	...	...	...	...	25
1924	Yale	Mich.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	6	13	*10*	9	4	...	1	...	...	...	...	...	45
1924	Otisville	Mich.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	3	6	*19*	5	4	2	...	...	...	...	...	...	...	40
1926	Otisville	Mich.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	7	*1*	4	4	...	1	...	...	...	...	...	...	19

TABLE IV (Continued)

IRIS VIRGINICA (Continued)

Year	Town	State	Individuals of each colony classified according to size																															
			Anther length in centimeters															Total number	Crest in centimeters															Total number
			.7	.8	.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1		.7	.8	.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	
1924	Fay Bridge	Mich.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	3	3	1	1	2	..	...	...	...	...	...	13
1926	Frankenmuth	Mich.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	3	4	9	*8*	4	5	1	...	...	...	...	...	...	35
1927	Frankenmuth	Mich.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1926	W. Saginaw	Mich.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	2	*5*	2	4	1	...	...	...	...	...	...	16
1926	Linwood	Mich.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	5	*10*	7	3	1	2	...	1	...	...	...	30
1927	Linwood	Mich.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1924	Muskegon	Mich.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	6	*14*	11	8	1	1	...	...	...	...	...	...	43
1924	Albert Lea	Minn.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	1	..	1	...	...	...	...	...	...	...	...	4
1924	Hayward	Minn.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	1	2	3	1	...	...	...	...	1	...	...	10
1924	La Crosse	Wis.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	3	3	12	*12*	7	5	5	2	...	...	...	...	51
1927	Pardeeville	Wis.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1924	Slinger	Wis.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	6	*15*	7	3	2	...	...	...	...	...	...	33
1925	Pelee Is.	Ont.	...	...	...	...	...	...	4	1	...	...	...	...	...	...	...	5	...	...	...	2	1	...	...	1	...	...	...	...	...	...	4
1927	Kettle Point	Ont.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

TABLE IV (Continued)

IRIS VERSICOLOR

Year	Town	State	Individuals of each colony classified according to size																													
			Anther length in centimeters															Total number	Crest in centimeters													Total number
			.7	.8	.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0			.7	.8	.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	
1927	Hood	Md.																														
1927	Liverpool	Pa.																														
1925	Harmonsburg	Pa.	1	1		2	3	5	6	*15*	6	3						42	3	11	*14*	12	3										43
1925	Meadville	Pa.				1	1	1	7	2								12		1	6	2	1										10
1925	Greenville	Pa.				1		4	5	2	1							13	1	1	3	6	2										13
1924	Conewango	N. Y.																		1	1	2	5	*7*	7	3							26
1925	Conewango	N. Y.			1		3	*4*	*6*	2								16		2	3	*8*	2										15
1925	Cherry Creek	N. Y.				1	3	*7*	3	3	2							19		1	5	*8*	4	1									19
1927	Villenova	N. Y.																														
1925	Hubbardsville	N. Y.			2	4	4	*9*	8	5	2	1						35		2	6	9	*6*	9		3							35
1925	Pownal	Vt.				1	5	*12*	7	2								27	2	5	6	*10*	3	1									27
1925	Pownal Cent.	Vt.			1	16	*9*	5	3	1	1							36	3	7	*9*	*10*	8	1									38
1925	Clarendon	Vt.			2	4	9	*10*	7	3	2							37	2	5	3	*12*	12	3									37
1926	Middlebury	Vt.																				2	6	*8*	4	3	1						24
1926	New Haven Jc.	Vt.																		1	2	9	4	*9*	8	1							34
1924	Holderness	N. H.				1		2										3			1	1	1	1									4
1927	Duxbury	Mass.																														
1927	Alberton	Ont.																														
1926	Ottawa	Ont.																			1	3	11	*8*	7	1							31
1926	L. Timagami	Ont.																		1	1	4	5	*4*	4	4	2						25
1927	Truro	N. S.																														
1927	Antigonish	N. S.																														
1927	Baddeck	N. S.																														
1927	McAdam	N. B.																														

TABLE IV (Continued)

IRIS VERSICOLOR × I. VIRGINICA

Year	Town	State	Individuals of each colony classified according to size																												
			Anther length in centimeters														Total number	Crest in centimeters														Total number
			.7	.8	.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0		.7	.8	.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	
1927	Tawas City	Mich.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	1	3	4	3	...	...	...	...	...	...	...	11
1927	E. Tawas	Mich.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	3	3	3	1	1	...	...	...	...	11
1927	W. St. Ignace	Mich.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	5	7	7	8	5	1	2	...	...	...	35
1927	Engadine	Mich.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	1	...	1	2	7	3	10	4	...	...	...	...	28
1924	W. Yale	Mich.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	3	4	5	2	...	...	...	...	...	...	...	...	14
1927	London	Ont.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	2	4	6	4	2	2	...	...	...	...	...	20

separating the two species. It is thus apparent at the outset that no biometric method of distinguishing the two species can be a simple matter. While it is certainly true, as Hall and Clements ('23) and McLeod ('26) have suggested, that taxonomy needs the development of more exact methods, there are serious limitations to a wholesale inclusion of biometry in every-day taxonomic procedure.

These limitations may be easily demonstrated by a simple example. Figure 6 shows five petals of *Iris virginica* and five

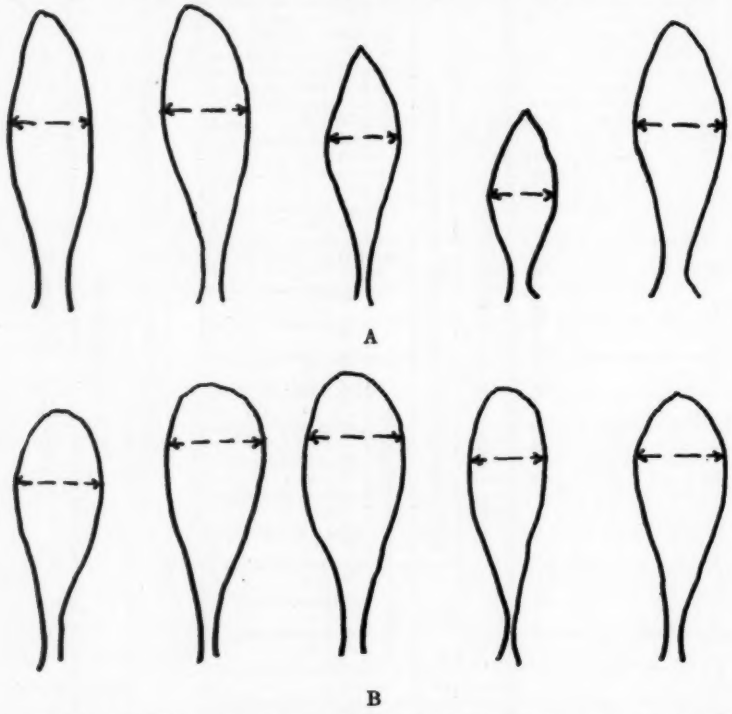


Fig. 6. *A*, outlines of five petals each of *I. versicolor; B*, outlines of five petals each of *I. virginica*,

of *Iris versicolor*. For the purpose of taxonomic description they may be conveniently and accurately separated by describing those of *Iris versicolor* as ovate-lanceolate and those of *Iris virginica* as

obovate-spatulate. To separate them by biometric methods is by no means so easy, as table v shows.

TABLE V

	Petal length	Petal width	Petal taper	Taper / width
Iris virginica	cm.	cm.	cm.	
No.				
1	4.2	1.4	1.5	1.1
2	4.7	1.7	0.8	0.5
3	4.8	1.7	0.9	0.6
4	4.6	1.3	1.1	0.9
5	4.6	1.6	1.2	0.8
Iris versicolor				
No.				
1	4.7	1.3	2.0	1.5
2	4.8	1.5	1.7	1.1
3	4.1	1.2	1.3	1.1
4	3.0	1.2	1.2	1.0
5	4.5	1.4	1.7	1.2

Neither the length nor the width will suffice. The taper (i. e. the length between the point of maximum width and the tip) is only somewhat better. The ratio between this latter measurement and the width is still better though it fails to separate the entire lot. None of the measurements is as good for purposes of distinction as the single terms "ovate-lanceolate" and "obovate-spatulate." Only by combining all three measurements into a complex ratio would it be possible to demonstrate, mathematically, the discontinuity between the two sets of petals. As Minot (quoted by Thompson, '17) has said, "The fact that men of genius have evolved wonderful methods of dealing with numerical relations should not blind us to another fact, namely, that the observational basis of mathematics is, psychologically speaking, very minute compared with the observational basis of even a single minor branch of biology. * * * While therefore here and there the mathematical methods may aid us, we need a kind and degree of accuracy of which mathematics is absolutely incapable."

The above example illustrates the two chief reasons why biometry must necessarily be limited in its application to taxonomy. In the first place, mathematics is swift and efficient only in recording differences in number; it becomes cumbersome in record-

ing differences in form, however useful it may be for a deeper analysis of the forces which produced the form. Yet it is just such differences in form which are most commonly met with in taxonomic work. This point is shown in a survey of the points on which specific distinction is based in two representative families. (one from the Monocotyledons and one from the Dicotyledons) in the seventh edition of Gray's 'Manual'. The differences were classified as being based on shape, on absolute size and number, and on comparative size and number. In all doubtful cases the preference was given to differences in number.

	Differences in shape	Differences in absolute size or number	Differences in comparative size and number
Iridaceae	21	13	12
Boraginaceae	31	11	9

There is an even more fundamental reason why the customary methods of mathematics are not well adapted to taxonomic work. Such methods are comparatively simple when the variations in one characteristic are being traced; they become involved and cumbersome when the simultaneous changes in a large number of variables are studied. Yet this last is essentially the method of the taxonomist. When he distinguishes between a group of sugar maples and a group of silver maples, for instance, he is summarizing a large number of differences—differences in form, size, color, and color pattern. Mathematics can deal with such problems through the study of correlation, but it is slow and laborious work and though it may be useful in the analysis of some particular problem it is not adapted to general taxonomic use.

An attempt has therefore been made to develop a new method of presenting biometric data which would combine the good points of the methods of mathematics and comparative morphology. Like mathematics, it is accurate and objective. Like morphology, it leaves something to the trained eye. This has been accomplished by diagramming the data in a series of ideographs. Figures 7 and 8 show how the four measurements on the petal and sepal are combined into a single figure. Essen-

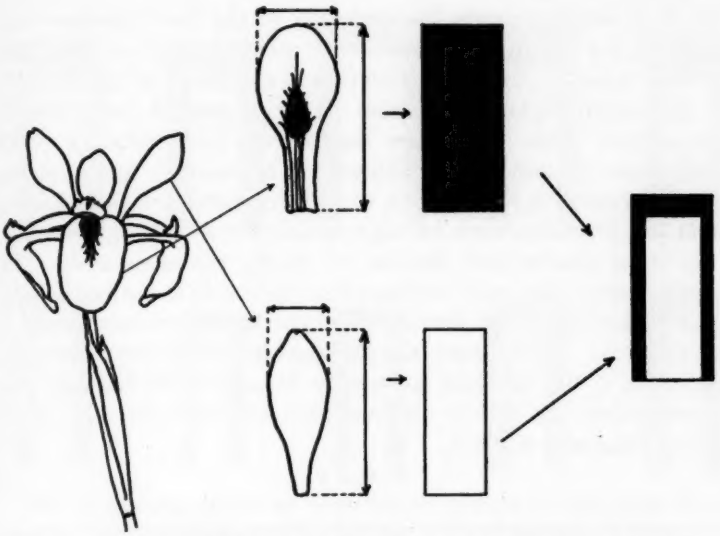


Fig. 7. Diagram showing typical flower of *I. virginica* and resulting ideograph.

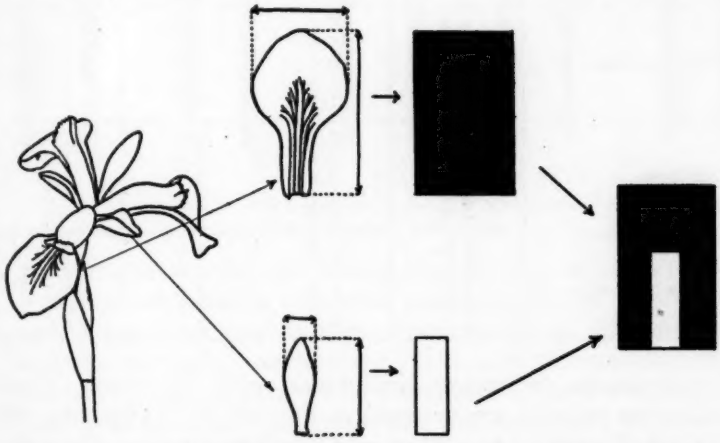


Fig. 8. Diagram showing typical flower of *I. versicolor* and resulting ideograph.

tially the ideograph consists of a diagrammatic white petal, superimposed upon a diagrammatic black sepal. By constructing an ideograph of this sort for each plant measured, it is possible

to show simultaneously the variation in the four variables considered, for an entire population of plants, or to compare the variation in one population with that in another as in figs. 10 to 13.

Such ideographs would seem to be of general usefulness in taxonomic work. They are capable of demonstrating slight differences in proportion which are not revealed by figures alone. In the genus *Iris*, for instance, though *Iris fulva*, *Iris foetidissima*, and *Iris prismatica* each belong to a different section of the genus, the three species have flowers of nearly the same size. The dimensions of the petals and sepals are so nearly the same that the species hardly appear distinct when the figures are compared, as in table VI. When these are arranged as ideographs, however, as in fig. 9, the essential differences in proportion between the three species are clearly demonstrated and they are seen to be morphologically distinct.

TABLE VI

COMPARISON OF FLORAL DIMENSIONS OF THREE SPECIES OF IRIS

	Sepal length in cm.	Sepal width in cm.	Petal length in cm.	Petal width in cm.
Iris prismatica	4.4	2.0	4.0	1.1
	4.9	1.8	4.3	1.2
	4.7	2.1	4.3	1.4
	4.8	1.8	4.6	1.1
	4.5	1.8	4.2	1.1
Iris fulva	4.9	2.2	3.7	1.4
	4.9	2.4	4.0	1.2
	5.6	2.6	4.5	1.6
	5.3	2.4	4.1	1.3
	5.0	2.2	3.9	1.1
Iris foetidissima	4.3	1.8	3.9	0.9
	3.9	1.6	3.6	0.8
	4.0	1.8	3.6	0.9
	4.4	2.0	3.9	0.8
	4.5	2.1	4.0	0.9

Ideographs for twenty individuals each of sixteen representative colonies are grouped in figs. 10–12 (*I. virginica*) and fig. 13 (*I. versicolor*). They give another proof of the striking variation in size and proportion which has been found in every colony studied. In marked contrast to the variation between individuals is the general resemblance between colonies of the same species. While several different colonies have slight

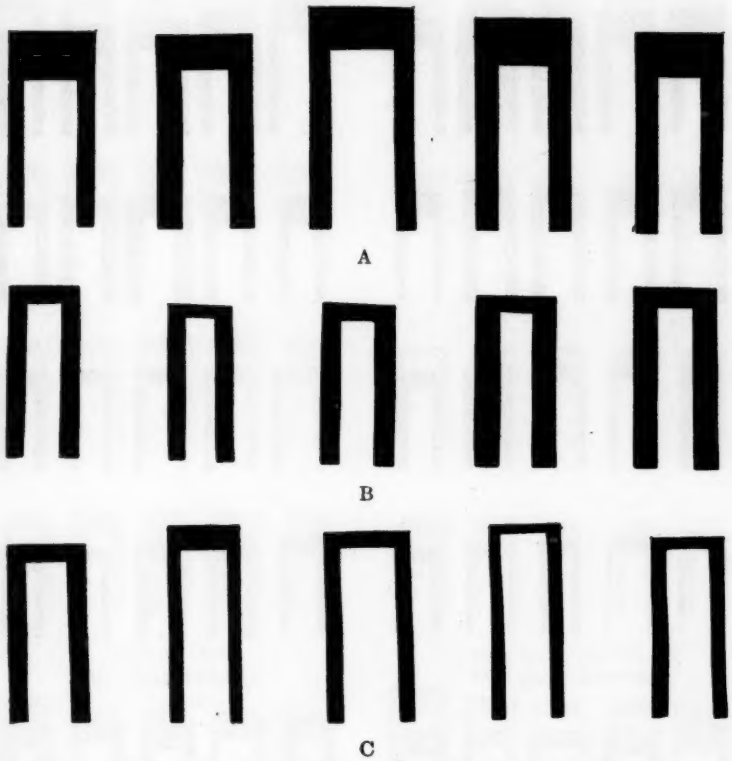


Fig. 9. *A*, ideographs of five plants of *I. fulva; B*, ideographs of five plants of *I. foetidissima; C*, ideographs of five plants of *I. prismatica.*

individual tendencies, and while in the case of those colonies which have been measured in successive years (fig. 10) the peculiarities persist from year to year, there is practically no differentiation between one region and another. The only generalization that can be made is that *Iris versicolor* becomes on the average a little smaller as one goes from north to south and that *Iris virginica* becomes a little larger. Thus, although the colony at Stanton, Kentucky (fig. 12), seems slightly unusual by reason of its comparatively large petals the other colonies studied in Kentucky and Tennessee (Bonnieville and Camden) do not show these peculiarities. There is as much variation in proportion and almost as

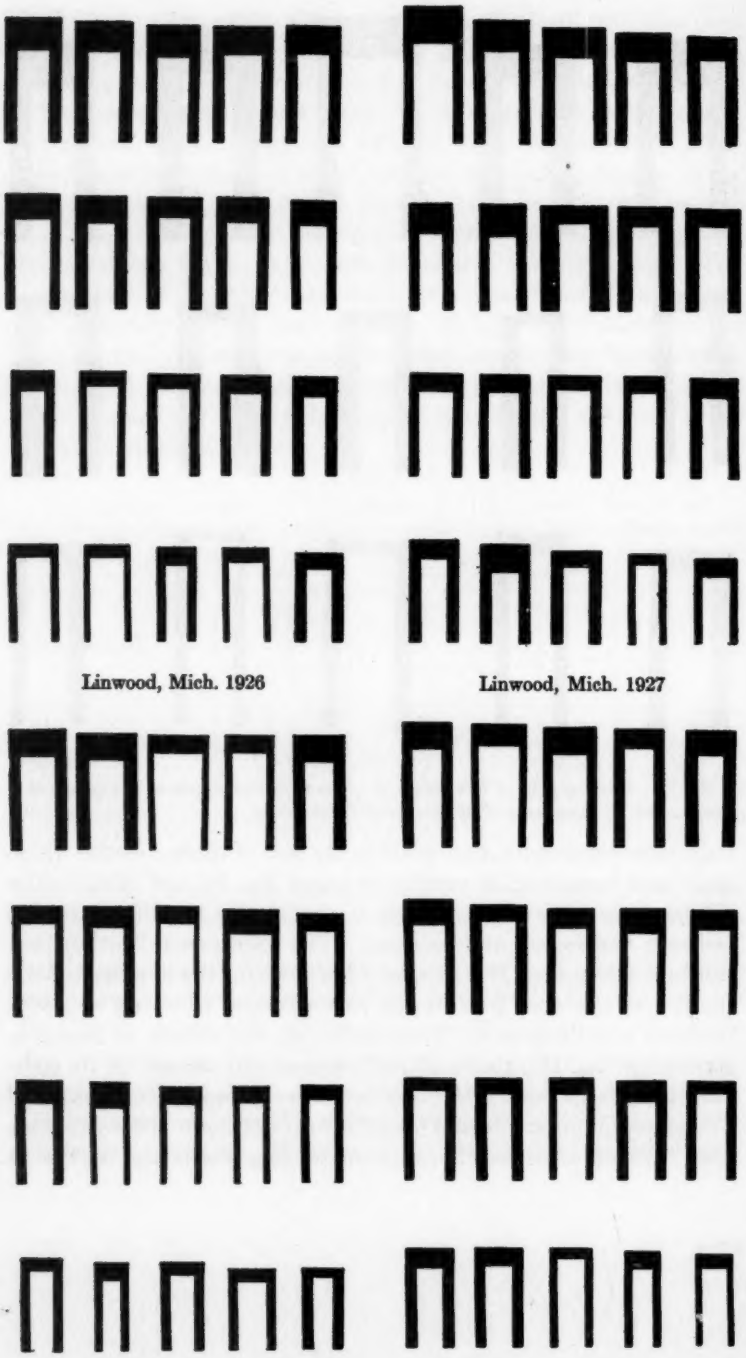


Fig. 10. Ideographs of twenty individuals each of four colonies of *I. virginica*.

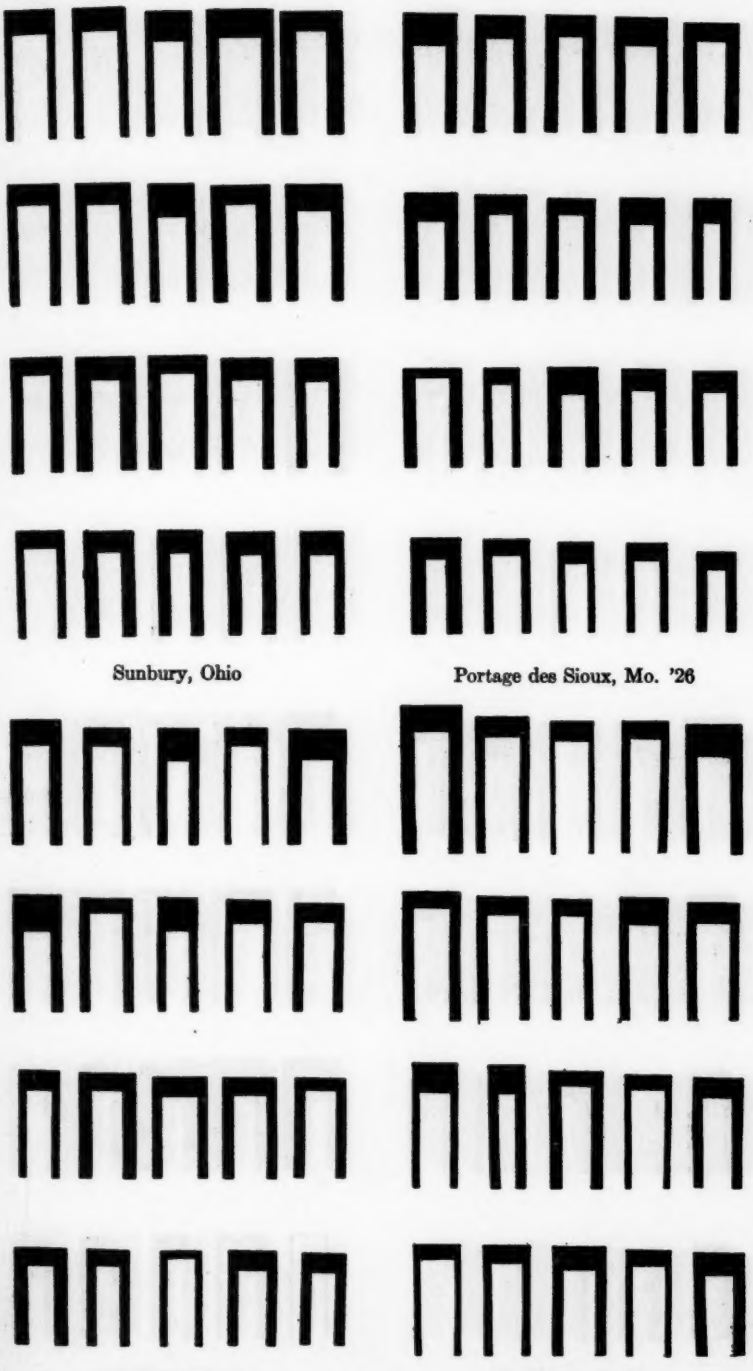


Fig. 11. Ideographs of twenty individuals each of four colonies of *I. virginica*.

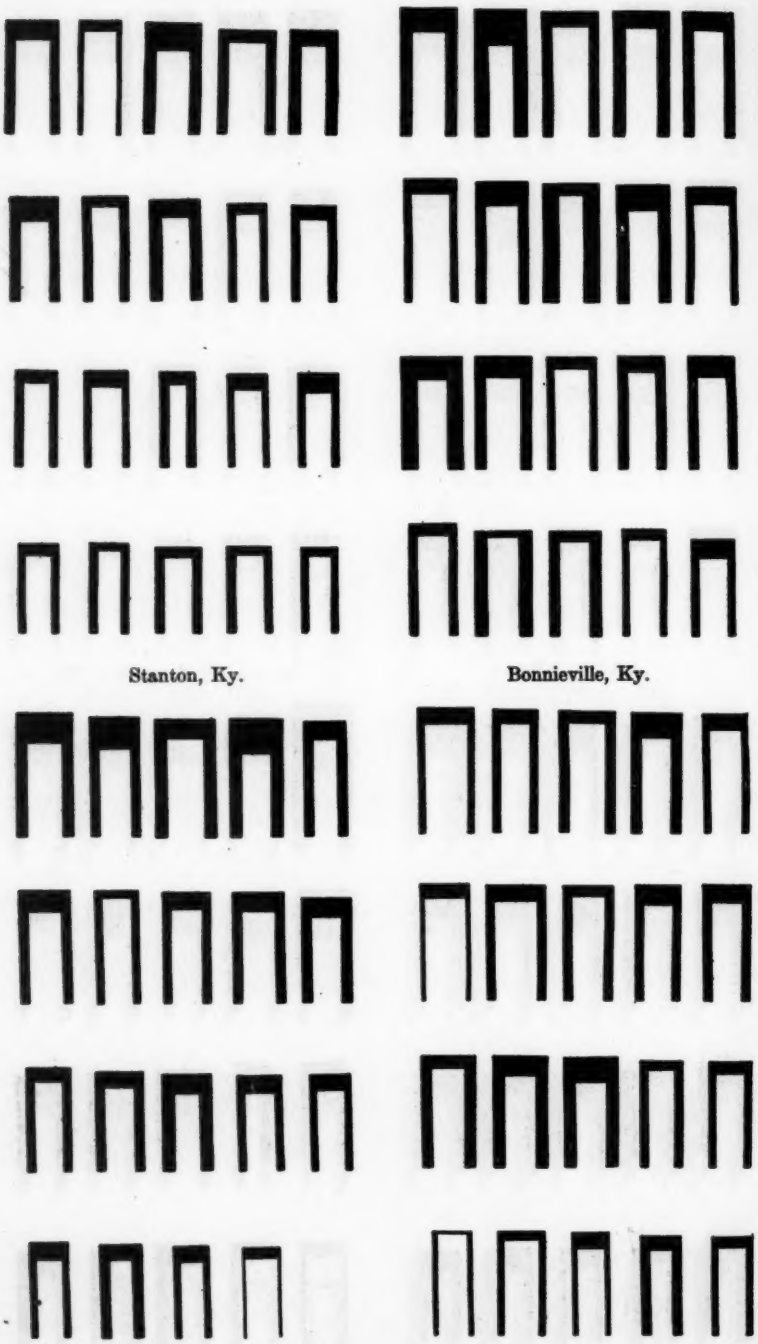


Fig. 12. Ideographs of twenty individuals each of four colonies of *I. virginica*.

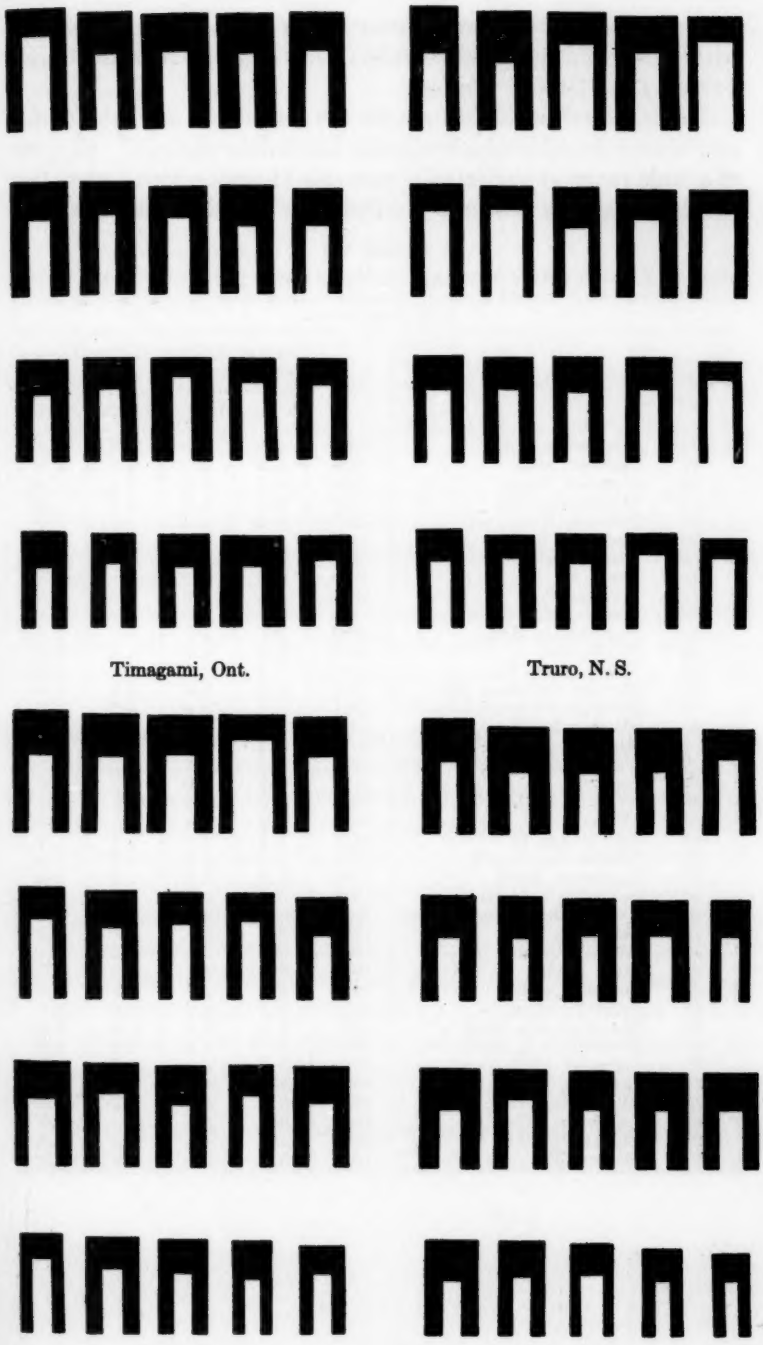


Fig. 13. Ideographs of twenty individuals each of four colonies of *I. versicolor*.

much in size in the colonies from southern Michigan as there is within the whole group of colonies of *Iris virginica* from the Great Lakes to the Gulf of Mexico.

Above all, when the ideographs are considered as a whole, the two species remain completely and absolutely distinct. In spite of a wide range of variation in separate characteristics, when the combination as a whole is studied it is found to be strikingly

TABLE VII

MEDIAN MEASUREMENTS OF IRIS FLOWERS FROM DIFFERENT LOCALITIES

IRIS VIRGINICA

Number of individuals	Locality	Year	Median sepal length in cm.	Median sepal width in cm.	Median petal length in cm.	Median petal width in cm.
25	Kimborough, Ala.	1927	6.3	2.8	5.7	1.8
21	Jackson, Miss.	1927	5.9	2.6	4.9	1.8
50	Camden, Tenn.	1926	6.7	3.0	5.7	2.0
35	Bonnieville, Ky.	1926	6.7	3.0	5.7	1.8
21	Stanton, Ky.	1926	5.5	2.6	4.9	1.6
20	Eastover, S. C.	1928	6.7	2.8	5.7	1.9
15	Maysville, N. C.	1928	7.5	3.0	6.1	2.0
38	Anna, Ill.	1926	6.3	2.8	4.9	1.8
27	Vulcan, Ill.	1925	6.3	2.6	5.3	1.8
15	Vulcan, Ill.	1926	6.3	2.6	5.3	1.6
38	Farmington, Ark.	1925	6.3	3.0	5.3	2.2
43	Wicks, Mo.	1925	5.9	2.6	4.5	1.6
23	Valley Park, Mo.	1926	5.9	2.8	5.3	1.8
40	Portage des Sioux, Mo.	1926	5.9	2.8	4.9	1.6
30	Portage des Sioux, Mo.	1927	6.3	3.0	5.7	2.0
28	Portage des Sioux, Mo.	1928	6.8	3.2	5.8	2.0
27	Louisiana, Mo.	1924	6.3	2.8	5.3	1.6
26	Fort Madison, Ia.	1924	5.9	2.8	4.5	1.6
30	Sunbury, O.	1927	6.7	3.0	5.3	1.9
28	Mill Creek, O.	1925	5.1	2.1	4.1	1.4
23	Huron, O.	1925	5.5	2.4	4.1	1.4
63	Bay Bridge, O.	1925	5.1	2.4	4.1	1.4
33	Middle Bass Is., O.	1925	5.1	2.6	4.5	1.6
30	Lawrence, Mich.	1926	5.9	2.8	4.9	2.0
30	Schoolcraft, Mich.	1926	5.9	2.6	4.9	1.8
30	Centerville, Mich.	1926	6.3	2.8	5.3	1.8
35	Hartland, Mich.	1926	5.9	2.8	4.9	1.8
25	Armada, Mich.	1924	5.5	2.2	4.1	1.4
45	Yale, Mich.	1924	5.5	2.4	4.5	1.7
43	Otisville, Mich.	1924	5.5	2.4	4.5	1.6
19	Otisville, Mich.	1926	5.5	2.4	4.5	1.8
35	Frankenmuth, Mich.	1926	5.9	2.6	4.9	1.8
30	Frankenmuth, Mich.	1927	5.9	2.8	4.9	1.8
30	Linwood, Mich.	1926	5.9	2.9	4.9	2.0
25	Linwood, Mich.	1927	5.9	3.0	4.9	1.8
25	Muskegon, Mich.	1924	5.5	2.4	4.5	1.6
52	La Crosse, Wis.	1924	5.9	2.6	4.9	1.6
27	Pardeeville, Wis.	1927	5.5	2.8	4.9	1.8
33	Slinger, Wis.	1924	5.9	2.4	4.9	1.8

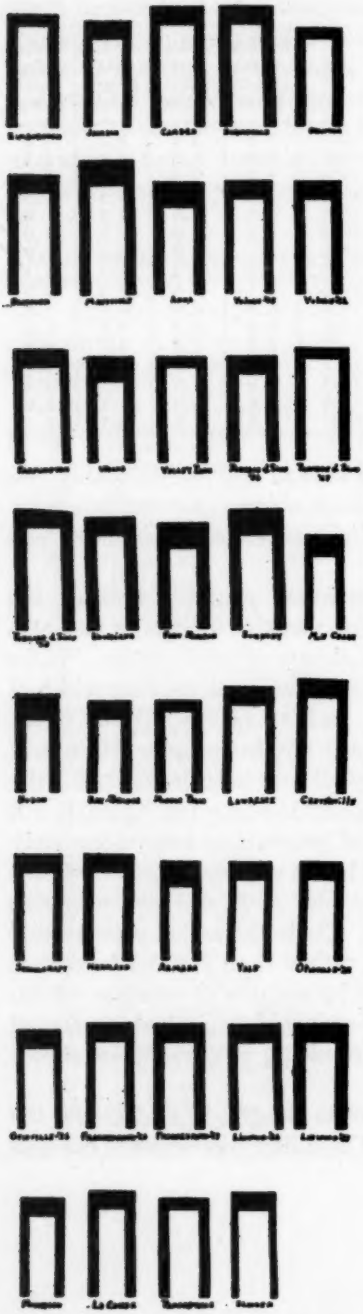
IRIS VERSICOLOR

Number of individuals	Locality	Year	Median sepal length in cm.	Median sepal width in cm.	Median petal length in cm.	Median petal width in cm.
28	Hood, Md.	1927	5.9	2.8	3.7	1.2
22	Liverpool, Pa.	1927	5.9	3.0	4.1	1.4
35	Harmonsburg, Pa.	1925	5.5	2.8	3.3	1.2
29	Conewango, N. Y.	1924	5.9	3.2	4.1	1.8
28	Villenova, N. Y.	1927	5.9	3.0	4.1	1.6
35	Hubbardsville, N. Y.	1925	5.5	2.6	3.3	1.0
27	Pownal, Vt.	1925	5.1	2.2	3.3	1.0
38	Pownal Center, Vt.	1925	5.1	2.4	3.3	1.1
37	Clarendon, Vt.	1925	5.1	2.6	3.3	1.0
34	New Haven Jct., Vt.	1926	5.9	3.0	4.1	1.5
25	Middlebury, Vt.	1926	5.9	3.0	4.1	1.4
20	Duxbury, Mass.	1927	5.5	2.8	3.7	1.4
26	Alberton, Ont.	1927	5.5	3.0	4.1	1.6
32	Ottawa, Ont.	1926	5.9	3.0	4.1	1.4
26	Timagami, Ont.	1926	5.9	3.2	4.1	1.2
22	Truro, N. S.	1927	6.3	2.8	4.1	1.4

constant. *Iris versicolor* remains always and unmistakably *Iris versicolor*. and *Iris virginica* remains always and unmistakably *Iris virginica*. There is not the slightest tendency for one species to merge into the other.

By employing another mathematical concept, that of the average, we can construct a different sort of ideograph and produce something like a composite picture of each colony. If for each colony we take the average length of sepal, average width of sepal, average length of petal, and average width of petal, and construct an ideograph we will obtain a figure which will present graphically the averages of all four measurements for the colony in question. It will be a purely hypothetical figure; it will not necessarily present the kind of proportions most commonly met with in the particular colony but it will serve for convenient comparison between separate colonies and between successive measurements of the same colony. As in the earlier presentation of averages, the median is used rather than the mathematical mean because it is less influenced by occasional extreme values. The median values and also the number of individuals measured are presented in table VII. The resulting ideographs are shown in fig. 14.

The examination of these composite ideographs strengthens the conclusions already arrived at. The differences between colonies



Composite ideographs of 39 colonies of *I. virginica.*

Composite ideographs of 16 colonies of *I. versicolor.*

Fig. 14.

are very slight. In spite of the fact that the colonies measured extend from the Gulf Coast to the Great Lakes in the case of *Iris virginica*, and from Maryland to the north woods in the case of *Iris versicolor*, there is practically no evidence of regional differentiation; that is, of the formation of morphologically distinct geographical subspecies within either *Iris versicolor* or *Iris virginica*. As before, *Iris versicolor* is seen to become slightly dwarfed towards the South, whereas *Iris virginica* is smaller in the North. The general proportions of each species, however, remain strikingly similar throughout their entire ranges. There is no outstanding difference in proportion which characterizes any one region, though individual colonies may show slight peculiarities. Thus while the colony at Wicks, Missouri, is distinctive by reason of its proportionately small petals, that at Valley Park, Missouri, only a few miles away, is characterized by proportionately large ones, while the near-by colonies of Portage des Sioux, Missouri, and Vulcan, Illinois, have petals of about average proportions.

In addition to differences in size and proportion, another sort of difference has been noted in the plants grown in the experimental garden. There is a general tendency, in both species, for the plants from northern colonies to come into bloom sooner than those from southern colonies. There is a good deal of variation in blooming time within each locality, of course, and this will mask the general tendency to a certain extent but for three springs it has been observed that the earliest plants to come into bloom are from northern colonies and the latest are those from southern ones.

Aside from differences in size and in blooming periods no consistent regional differences have been found within either species. It is, of course, possible that such differences existed but were not revealed by the methods used. However, these methods did distinguish successfully between the two species. If regional differences do exist, they must be of an entirely different order of value from the differences between species.

CHARACTERISTIC TENDENCIES

Quite as remarkable as any clear-cut differences between the two species were certain characteristic tendencies of one or the

other species to depart from the normal. The spathe valves of the two species are usually very similar, the longest ones of *Iris versicolor* and the shortest of *Iris virginica* being quite indistin-

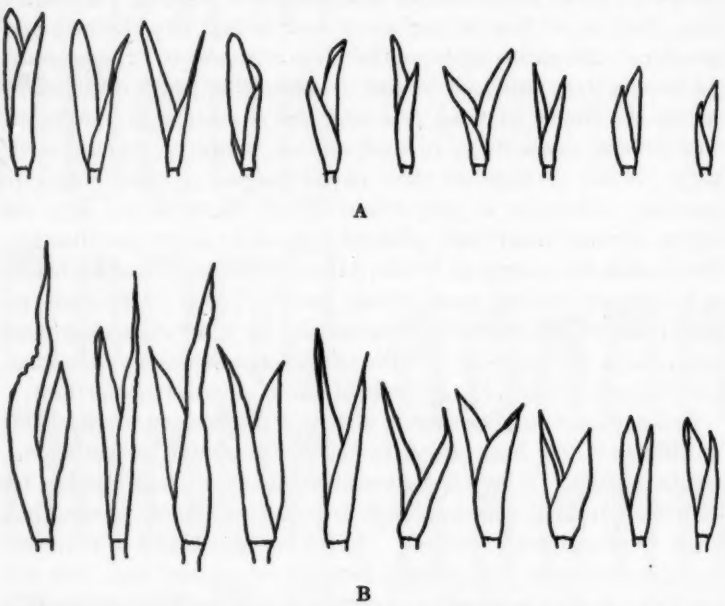


Fig. 15. *A*, range of variation in spathe valves of *I. versicolor*, × ½; *B*, range of variation in spathe valves of *I. virginica*, × ½.

guishable morphologically. Those of *Iris virginica*, however, occasionally become long and foliaceous like those of *Iris hexagona;* those of *Iris versicolor* were never seen to do so. *Iris virginica* often (in nearly 50 per cent of the cases examined) had a terminal notch in the petal. Only twice have such notches been seen in *I. versicolor*. They were not due to mutilation, since they could be found in buds several days before opening; they were probably correlated with a dichotomy of the vascular system of the petal. More or less associated was a tendency on the part of *Iris virginica* to produce ruffled, crimped, or even crenate petals. Flowers exhibiting these characteristics are shown in pl. 34. Only once or twice was the tendency observed in *Iris versicolor* and even

then it was not highly developed. These are only a few of a host of variable characters which were occasionally expressed in one species and rarely or never in the other.

There is nothing new in this experience. It has been the common lot of all who have attempted to distinguish groups of organisms, be they species or families or phyla. The quotation from Bergson which Mrs. Arber ('25) uses in distinguishing between the Monocotyledons and the Dicotyledons is quite as appropriately used here as there. "The group must not be defined by the possession of certain characters but by its tendency to emphasize them."

The point in calling attention to this commonplace phenomenon is to suggest that if most of the differences between species are of this sort, taxonomists might well undertake surveys of variation within the species they are treating, on a scale much larger than is customary at the present time. Such studies should be particularly important in any attempt at a phylogenetic treatment of related species. *Iris virginica* is closely related to *Iris hexagona*, for instance, and one of the morphological indications of this relationship is that in about one case out of fifteen or twenty the spathe valves of *Iris virginica* are foliaceous like those of *I. hexagona*.

PECULIAR FORMS

A few of the individuals observed have been so unusual as to deserve special mention.

Albinos.—Complete albinos with no trace of color other than yellow have been found only in *I. virginica*. These were found at two places, at Lawrence, in western Michigan, and near Lake Saint Clair, in Ontario. Partial albinos are fairly common in both species. They are white, shaded or faintly lined with blue. They have been observed at the following localities:

I. virginica—Lawrence, Michigan (in same colony with albino); Farmington, Arkansas; Maysville, S. C.; Dennison, Mich.

I. versicolor—Timagami, Ontario; Central Connecticut (M. E. Mains).

Occasional individuals were found in each species in which the flower color is lavender or red-purple instead of blue. One such

form has been offered in flower catalogues for some years under the name of *I. versicolor kermisina*. Similar color forms have been found at the following localities:

I. virginica—Otisville, Mich.; Burke, Iowa; Camden, Tenn.
I. versicolor—Stratford, N. H.; Hubbardsville, N. Y.

Occasional individuals were found with sepals strongly reflexed. Three flowers from such an individual are illustrated in pl. 39, figs. 7–9.

THE GENETIC RELATIONSHIPS OF INDIVIDUAL DIFFERENCES IN IRIS VERSICOLOR

An experiment is under way to determine, for each species, the extent to which the peculiarities which characterize individual plants are passed on to their offspring, under the conditions obtaining in nature; in other words, to determine, from an inspection of the variation between sister seedlings, the amount of interbreeding which takes place under natural conditions. If the species is naturally self-fertilized ninety-nine times out of a hundred, all seedlings grown from a single parent plant should be practically alike and similar to the parent. If, however, there has been continuous out-crossing with other individuals, the sister seedlings should differ from each other and from the parents; as much, for instance, as human brothers and sisters differ from each other.

Several such series of sister seedlings from seed-pods collected on plants of *Iris versicolor* at Connecticut Lakes, N. H., bloomed in 1928. There were not enough flowers per plant to make careful qualitative studies but there were sufficient to allow certain preliminary conclusions to be drawn. One of these series is illustrated in pl. 40, and shows one flower from each of five sister plants. It will be noted that while the flowers are in general very similar, they are not as much alike as flowers from the same plant (see pls. 37, 38 and 39, where series of flowers from the same plants are illustrated). They are, however, much more alike than are the general run of individuals in a colony (see pl. 34).

The most conspicuous differences are in regard to the petals. Those of figs. 9, 5, and 6 (pl. 40) are unusually broad and flat, those

of number 7 are somewhat smaller, while number 8's are narrow and folded. There were accompanying differences in color which are only suggested by the photographs. Number 8, for instance, was distinctly lilac, while the others were blue. Similar results have been obtained in all the series of *Iris versicolor* which have blossomed to date. It is therefore concluded that *I. versicolor*, though usually self-fertilized, is frequently cross-pollinated under natural conditions. The relation of this conclusion to the question of Jordanons or micro-species, is deferred to the Discussion.

Hybridization of Iris versicolor and Iris virginica
A preliminary report

It has been found upon experiment that *Iris versicolor* and *Iris virginica* are partially fertile in crosses with each other. There has not yet been enough material in the breeding plot to make exact quantitative studies, but whereas nearly all the crosses which have been tried *within* either species have set seed, only

Fig. 16. Ideographs of three hybrid plants; left, natural hybrid from Engadine, Mich.; center, artificial hybrid produced at the Missouri Botanical Garden; right, natural hybrid from London, Ontario.

slightly more than half of those *between* the two species have done so. The resulting hybrid seed has a low percentage of germination and the seedlings show hybrid vigor. This was particularly noticeable when the young seedlings were grown in the cold-frame side by side with seedlings of the parent species. The seedlings

of *Iris versicolor* and of *Iris virginica* varied greatly in vigor, whereas the hybrid seedlings were all uniformly vigorous.

Of the various crosses which have been made, two have flowered. They are reciprocal crosses between plants I-AAA-3 and IAAG. I-AAA-3 is a plant of *Iris virginica* collected at Flint, Michigan, in 1923, and is illustrated in pl. 41, right figures. It is large-flowered and the flower has bright blue veining on a light background. The petals are unusually broad. IAAG is a plant received from Dr. J. R. McLeland of Pleasanton, Kansas, though it came originally from Medina, N. Y. It is a typical *Iris versicolor* and is outstanding in the dark color of its flowers and its stems. It is illustrated in pl. 41, left figures.

The seedlings of cross IXB (I-AAA-3×IAAG) were similar in size, leaf number, leaf height, etc., to the most vigorous plants of either parent species. The seedlings of the reciprocal cross, IXA (IAAG×I-AAA-3) were even more vigorous. Plants one and two years old grown from seed showed leaves one fourth again as high and about half again as many leaves per plant as the parents.

IXA and IXB flowered for the first time in 1927. Ideographs and photographs of their flowers and of those of the parent species are shown in fig. 16 and pl. 41. It should be emphasized that the measurements and pictures of IXA and IXB were made from plants growing in the cold-frame. They would have been much larger if grown in the water-side plots with the other plants. Thirteen plants of IXA and three plants of IXB were brought to flowering age. The two sets of hybrids were very similar aside from the greater vigor of IXA. While the seedlings varied slightly among themselves they were remarkably uniform in general aspect. They were intermediate in all the differences which characterize the two parents, though they were easily distinguished by their vegetative vigor. In general appearance and in practically all measurable characters they much more closely resembled *Iris versicolor* than *Iris virginica*. Their most outstanding differences from *Iris versicolor* were their much larger and laxer petals and the peculiar spots at the base of the sepal. The spots were due to the combination of the bright yellow pubescent spot of *Iris virginica* and the dark blue cross-

veining and brown stippling of *Iris versicolor*. The resulting "eye" is unlike anything in either species.

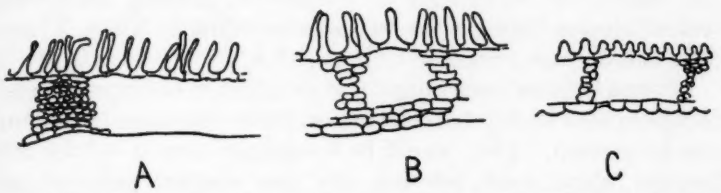


Fig. 17. Cross-sections of sepals showing pubescence: *A*, *I. virginica*; *B*, *I.* × *robusta*; *C*, *I. versicolor*; × 25.

A microscopical examination of the pubescence of the sepal showed that of the hybrid to be intermediate in form between the two species though, due to the larger cells of the hybrid, it is almost as long as that of *Iris virginica*. Camera-lucida drawings of all three are shown in fig. 17. The hybrid was likewise intermediate in the glandular development at the base of the stamens. Figure 18 shows cross-sections of the perianth tubes.

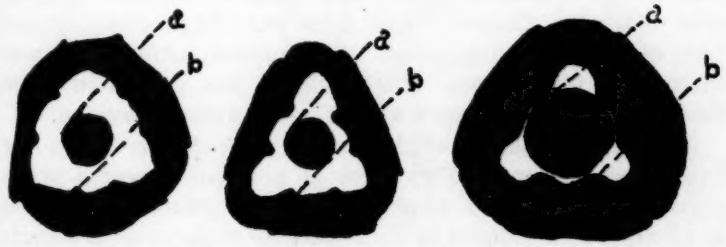


Fig. 18. Cross-sections of perianth tubes showing, *a*, style, and *b*, glandular development of inner wall of tube; left, *Iris versicolor*, right, *I. virginica*, center, *I.* × *robusta*.

The plants of crosses IXA and IXB were partially sterile. Counts showed about 50 per cent abnormal pollen and many of the ovules aborted. Ovaries with one exposed locule are shown in pl. 41. The plants from which the capsules were taken were growing in the same cold-frame and had had an equal opportunity for pollination. All of the seed capsules on the hybrid plants were small and shrunken.

Numerous other hybrids between the two species have been

made, and while they have not flowered they are similar in their vegetative characteristics to those already described. Dr. J. R. McCleland, an iris amateur of Pleasanton, Kansas, has grown several crosses between the two species, some of which I have seen, and they are similar to IXB and IXA.

Natural hybrids resembling those produced in the experimental plot have been found at several points where the ranges of the two species overlap. They would be commoner were it not for the barriers which exist between the two species; geographical barriers such as the extensive limestone areas west of the Alleghenies in which neither species is common; physiological barriers which prevent them from being wholly fertile with each other. The location of the hybrids and their relation to the distribution of the parent species is shown in fig. 19.

Most of the hybrids found were very similar to those produced in the experimental plot. Those observed in Ontario resembled the garden-made hybrids very closely. There was little variation between them although they were found in several places. They were nowhere particularly abundant except in one creek bed just west of London, Ontario, where there was a large colony, apparently all belonging to one clone. *Iris virginica* was fairly common throughout this district. *Iris versicolor* was not found there though it was fairly common a short distance east of London.

At Yale, Michigan, a single plant of *Iris versicolor* and a few hybrids were found. They were in a meadow near a small graveyard from which *I. versicolor* may have spread. There were no plants of *Iris virginica* in the immediate neighborhood, though it is common in eastern Michigan and there were large colonies within two miles. An extensive search of the neighborhood failed to locate any other plants of *Iris versicolor* or of the hybrids.

At Tawas City, Michigan, a single hybrid plant was found growing along the roadside among a group of plants of *Iris versicolor*. A colony of *Iris virginica* was found less than half a mile away.

At only two points were the hybrids found making up large colonies. These were both in the northern peninsula of Michigan, and though only a few miles apart they were so different in their composition that a separate description will be given of each.

Fig. 19. Distribution of natural hybrids between *I. versicolor* and *I. virginica* (*I.* × *robusta*) in relation to that of the parent species.

WEST ST. IGNACE

Along the main highway three miles west of Saint Ignace a very remarkable colony was located. It had apparently originated by the intermingling of the two species, followed by numerous crosses and back crosses. The ideographs in fig. 20 give a slight idea of the bizarre mixture of types which was encountered; there was everything from typical *versicolor* to typical *virginica* with numerous intermediates and a number of very curious forms unlike anything seen before either in wild colonies or in the experimental plot. Most of the plants exhibited a high degree of vegetative vigor, though the environment did not seem to be unusually favorable.

ENGADINE

At Engadine, a few miles west of West St. Ignace another peculiar colony was found. It was most remarkable by reason of the great vegetative vigor of the plants. There was a degree of variation between the plants quite comparable to that found in colonies of the parent species, but by no means so extreme as that found in the colony at West St. Ignace. The plants were all very similar in their general aspect to the hybrids produced in the experimental plot. Ideographs of the colony show its lesser variability, and show the general similarity to the experimentally produced hybrid in fig. 16.

Though admittedly difficult, if not impossible, to distinguish by means of ordinary herbarium material, the hybrid appears of sufficiently common occurrence to warrant a special name.

× **Iris robusta** E. Anderson,[1] new hybrid
(*Iris versicolor* × *I. virginica*)

Intermediate between *Iris versicolor* and *I. virginica*, but more robust; partially sterile.

V. Summary

The common blue flags of eastern North America are found to be made up of two separate and distinct species; a northern and

[1] **Iris robusta** E. Anderson
(*Iris versicolor* × *I. virginica*)
Virginicam et versicolorem intermedia sed robustior, partialiter sterilis.

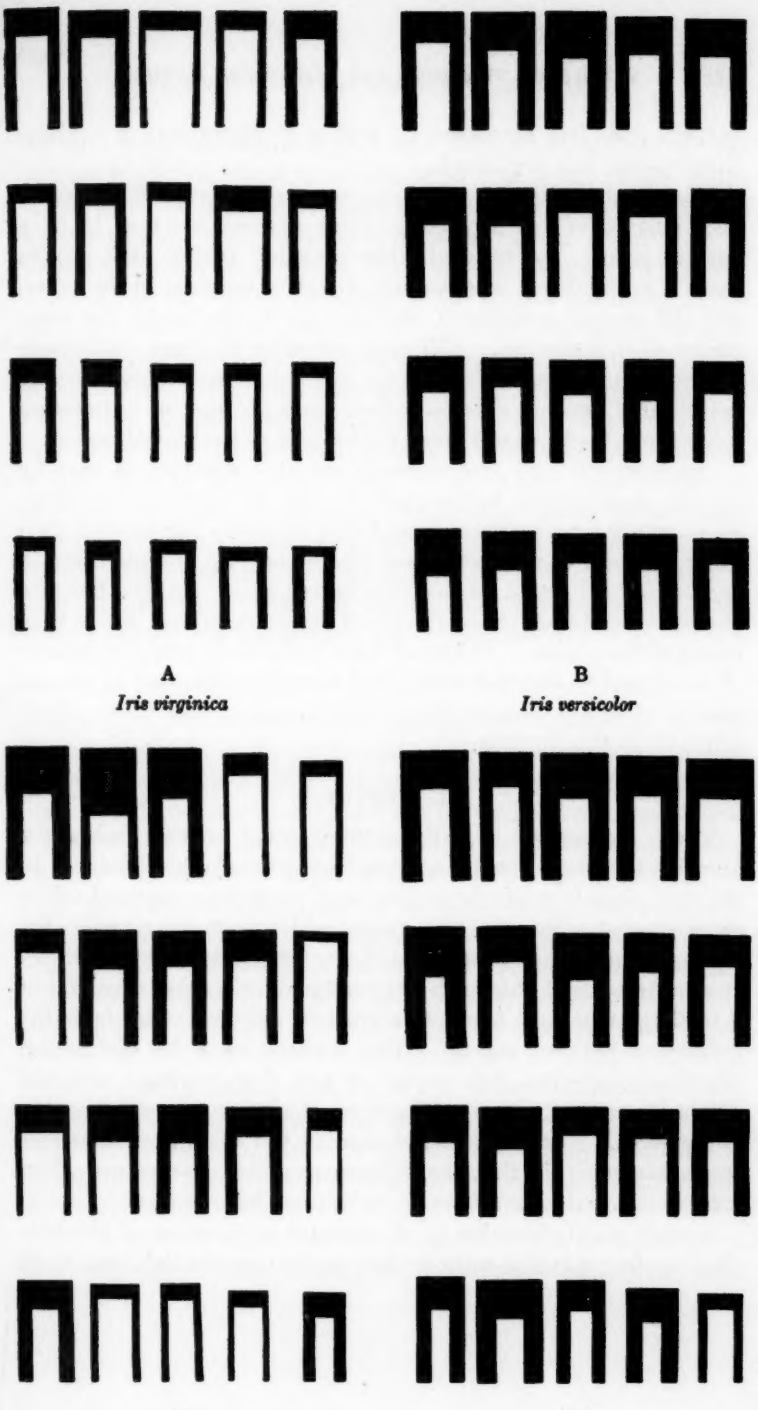


Fig. 20. Ideographs of twenty individuals each of the two hybrid colonies studied: *C*, West St. Ignace, Mich.; *D*, Engadine, Mich.; above, average colonies of *I. virginica* and *I. versicolor* for comparison.

eastern one, *Iris versicolor* L., and a southern and a middle-western one, *Iris virginica* L.

Statistical studies have been made of 16 colonies of *Iris versicolor* and 39 of *Iris virginica*. Each species is found to be a natural group. In spite of wide variation within each species there is no tendency whatsoever for one to merge into the other, and the general average of each species is practically the same wherever it is studied. Although variation between individuals is met with in every colony examined it has not resulted in any appreciable regional differentiation, since the species in question moved into their present home at the close of the glacial period.

Iris versicolor and *Iris virginica* are kept separate in part by natural geographical barriers and in part by physiological differences which prevent them from being perfectly fertile with each other. Along the narrow zone where the two species come in contact hybridization occasionally takes place. Natural hybrids, closely resembling those produced experimentally, have been found at five points. At two of these localities hybrid populations of considerable size had arisen and have been studied in greater detail. There is some evidence that constant new forms might originate in this manner.

VI. Discussion

There are several objections which must be met before the above conclusions can be accepted as generally applicable. In the first place it might be argued that there were regional differences present within the two species which were not revealed because of the methods used, the characters chosen for study, etc. It is quite possible that such unrecognized differences existed, but if so they must have been of an entirely different order from the differences between species. The methods used *did* distinguish effectively between *Iris versicolor* and *Iris virginica* and did demonstrate that no such differences existed within either of the two species. For the material studied the conclusion therefore seems unavoidable that *the differences within species are of an entirely different nature from the differences between them.*

A more valid objection to the general application of the conclusions drawn in this work is that the two species belonged to an

old and well-defined genus and that different relations between species might be found to obtain in such a group as the genus *Aster*, for instance. From purely *a priori* reasoning it would seem quite possible that distinctions between species might be of a different nature in different parts of the vegetable kingdom. Conclusions drawn from a study of two species belonging to the Monocotyledons would certainly have to be confirmed with more closely related material before they could be accepted as valid for such a distantly related group as a genus of the Compositae.

Another hindrance to the general application of the conclusions reached in the study of these two species is the geophysical nature of the region in which they occur. It is without great barriers of any sort. With a greater degree of isolation, such as would occur in a region cut by great mountain chains, the differences *within* species might perhaps be very different. It would be particularly interesting to compare the regional differentiation of the closely related western species, *Iris missouriensis*.

LINNAEAN VS. JORDANIAN SPECIES

The main conclusion drawn from this investigation is that the Linnaean species is a natural and permanent group. It should therefore be the most effective one for purposes of classification. In regard to Jordanian species I am in complete agreement with Clausen ('27) when he says, "The old botanists worked according to their own common sense and delicate biological feeling, but they had a conception of species far more nearly coinciding with what we now arrive at by careful statistical observation of variation in the field and by cytological investigations and crossing experiments than our modern small-species taxonomists. 'Eine Art ist eine Art, ganz gleichgultig ob sie *Diapensia lapponica*, *Viola tricolor*, oder *Hieracium marginelliceps* heisst', says du Rietz. I quite agree that it is a matter of supreme indifference to Nature what *we* decide shall be the definition of a species. But it is by no means a matter of indifference to ourselves whether we accept or reject a form of nomenclature which obscures Nature's own chief system of division."

In my opinion those who have considered the Jordanon to be of prime importance, taxonomically and phylogenetically, have

ascribed undue significance to the fact that it comes true from seed. With more genetical or horticultural experience they would have realized that coming true from seed (homozygosity) is a mere corollary of the amount of inbreeding which has taken place and that it is of minor taxonomic and phylogenetic significance.

We can best demonstrate the actual significance of the Jordanon's true-breeding quality by examining the relationships between individuals in two different sorts of species; in one continuously cross-pollinated and in one continuously self-pollinated. These relations are diagrammed in fig. 21 at a and b. Let us take four individuals of a continuously cross-pollinated species, such a one as *Aster anomalus*, for instance, to name one that has actually been investigated (unpublished data). We may diagram these four individuals as **A**, **B**, **C**, and **D** (b, fig. 21) and if we examine them they will be found to possess certain inherent differences in such characteristics as the number, length, and shape of the ray flowers, the number and arrangement of the branches of the inflorescence, etc. Though two individuals may sometimes agree in a single characteristic, no two will possess the same combination of characters. In the next generation, however, none of these particular combinations will reappear. Plant **A** will be pollinated by pollen from other plants, as, for instance, by **B** as in the diagram, and the resulting offspring will show new combinations of characters unlike anything in the previous generation. In the diagram one of them is taken as an example and named **L**. Plants **M**, **N**, and **O** are similar new combinations arising from cross-pollinations between the other plants of the previous generation. There will be similar new recombinations of characteristics for each new generation. In other words, there will be just such a reshuffling of characteristics as occurs from generation to generation in human families; man being another species in which similar out-crossing prevails.

If we now turn to a self-pollinated Linnaean species and study the differences between individuals we will find that they are very similar to those studied in *Aster anomalus*. We may therefore diagram them similarly (a, fig. 21) as **A**, **B**, **C**, and **D**. In such a self-pollinated species, however, a single individual acts as father and mother for the next generation. There will ordinarily

be no crosses between A and B or B and C as there were in *Aster anomalus*. Furthermore, since such close inbreeding has obtained in the past, each individual will be practically homozygous (pure-breeding), and its progeny will resemble their parent and each other very closely. The seedlings of A will be so similar to their parent that they can be diagrammed as A, those of B will show the same combination of characters which distinguished B from A, C, and D, and may be diagrammed as B. This resemblance will continue from generation to generation as long as no cross-pollination occurs. Such a species is therefore divisible into a number of pure lines or Jordanons.

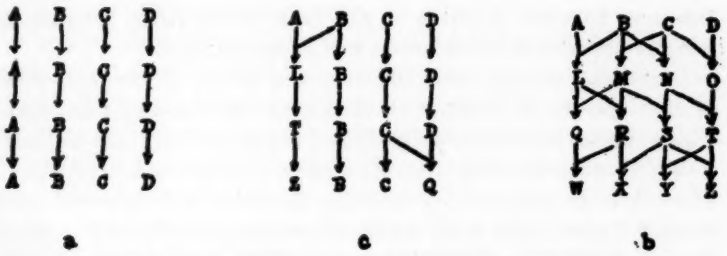


Fig. 21. Diagrammatic representation of the relationships between individuals in *a*, a self-pollinated species, *b*, a cross-pollinated species, and *c*, in *I. versicolor*.

It will be seen that the reappearance of distinctive combinations of characters from generation to generation is a mere corollary of the amount of inbreeding. Those Linnaean species which are continuously cross-pollinated will form new combinations in every generation. Those which are continuously self-pollinated will be divisible into recognizable pure lines or Jordanons. If species were of only these two sorts it might be possible to retain the Jordanon as an auxilliary unit, useful in the one case but not in the other. Unfortunately there is every transitional stage between the two extremes. *Iris versicolor* and *Iris virginica* are species of this intermediate sort. As has been shown above, *Iris versicolor* is usually self-pollinated though occasionally outcrossed. The relationships between individuals may therefore be diagrammed somewhat as in c of fig. 21. The diagram may be taken as typical of many species which can be only partially

separated into Jordanons. Those individuals, such as plants **A**, **B**, **C**, and **D** in the diagram, which have resulted from a long line of self-pollinations will give rise to true-breeding strains as long as they are self-pollinated. But when a cross-pollination occurs, as when **A** is crossed with **B**, it produces new recombinations of characteristics. In the diagram one of these new individuals, **L**, is taken as an example. Even though self-pollinated it will not breed true and its offspring will vary among themselves. One of them is represented in the diagram and named **T**. Plant **T** will likewise be too heterozygous to breed perfectly true, and its progeny must be given a new symbol in the diagram. So even though continuous self-pollination occurs among the progeny of the cross between **A** and **B**, it will take six or more generations before pure breeding Jordanons will be established.

Borrowing an idea from the diagrams in fig. 21, we may think of each species as a net, with the knots representing individuals. Those species in which cross-pollination regularly obtains will have a very short mesh, interweaving from one generation to the next. Those species, such as *Iris versicolor*, in which it is rare, will have a much longer mesh with fewer connecting cross-threads. Some few species will be so seldom cross-pollinated as to seem hardly net-like in their make up. They will be more like separate and unconnected knotted strings, but it is to be doubted if even in such extreme cases there never occurs a cross-pollination which brings the strings of the net together. Even though they occurred on the average only once in forty or fifty generations, it would cause the ultimate interweaving of the whole net and the disappearance of the single strings as separate units.

The case for the Jordanon as a universally applicable unit becomes even more absurd when we consider the case of a species which is cross-pollinated in one part of its range and self-pollinated in another. While this has not been demonstrated for any wild species, there is no *a priori* reason why such a delicately balanced relation might not vary under different environments. Leighty and Taylor ('27) have called attention to the fact that this has actually occurred in wheat which has different percentages of natural outcrossing in different parts of the world, as, for instance, in the Punjab where Howard and Howard ('09) report a very high

percentage. It has been found for numerous species that they are cross-pollinated only by a single insect. Such a Linnaean species, cross-pollinated in one part of its range and self-pollinated in another, would be divisible into Jordanons in the latter region but not in the former.

The division of a Linnaean species into Jordanons is therefore seen to be a mere corollary of the amount of inbreeding which has obtained in that species. Where Jordanons do occur they owe their existence to continuous self-pollination and their individuality disappears as soon as a cross-pollination takes place. In those species where cross-pollination is of rare occurrence they will undoubtedly persist for some time, perhaps even for centuries, but they will ultimately disappear.

These studies have shown that the Linnaean species, on the other hand, may retain its individuality, though submitted to widely differing environments, for long periods of time. *Iris versicolor* and *Iris virginica*, for instance, must have persisted as recognizable units since they spread into their present homes at the close of the glacial period. Important as the Jordanon may be in the case of cultivated plants, or in those Linnaean species in which it naturally occurs, it is a relatively temporary unit of little taxonomic or phylogenetic significance.

There remains to consider the bearing of the studies reported above on the question of the origin of species. For the material studied it has been shown that *the differences between species are of an entirely different order from the differences between individuals.* There is no evidence that these differences between individuals might, under the influence of natural selection or of any other natural force, eventually be compounded into differences comparable to those between the two species studied. This conclusion is not in accord with most current speculation on the subject. Since the time of Darwin it has been very commonly supposed that the processes which give rise to differences between individuals, if allowed to operate over a longer period, will produce specific differentiation. This general theory has gone through many phases as biology has advanced; in its most recent form it is held by many of the Drosophila workers who see in the gene mutation the unit process which, compounded a thousand-fold, results in specific differences.

There is little in the evidence reported in this paper to support such an explanation of the origin of species. If all the individual differences which have occurred in *Iris virginica* since the glacial period have not produced recognizable regional differences within the species, the production of new species by this means must be a very slow process.

If we are to deny the slow accumulation of individual differences an important role in species building, to what process are we to turn? A number of recent investigators, Brieger ('28) Clausen ('27), Karpechenko ('27), to name only a few, have reported the experimental production of true-breeding hybrids as the result of new chromosomal realignments. The careful experimental investigation of these hybrids has strengthened the case of those who believe with Lotsy ('16) that hybridization has been an important factor in the evolution of species. Though it has not been investigated cytologically, the colony studied at Engadine is apparently composed of similar true-breeding hybrids of natural origin. While it will have to be very thoroughly investigated before it can be taken as conclusive, this apparent example of a new and constant form produced by the hybridization of two separate species is certainly very suggestive.

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Explanation of Plate

PLATE 35

Fig. 1. *Iris latifolia Virginiana*, etc. Miller. From Ehret, G. D., Plantae Depictae, Tab. VI. 1748.

Fig. 2. *Iris latifolia Virginiana* etc. Miller. From Ehret, G. D., Plantae Depictae, Tab. VIII. 1748.

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1

Tab VIII
GIO DIONYSIO EHRET 1748
AL SINE procumbens Gallu forte Africana
IRIS latifolia Virginiana, &c. vide Tab VI fig 2
Flos apetalus, Calyx in 6 partes profunde divisus, seu mavis, incompletus quinque petalus.
Idem a latere sive a tergo visus.
Flos ope Microscopii visus. Stamina 3 pervium ambiunt, e cujus summitate ejusdem stigmata tria conspiciuntur. In Linnaei ejusq: Septimam, ad Triandria Trigynia pertinet: in Rivi & Tournefortii Methodos, ad Apetalos: nervum autem Genus ejus omnino videtur.
Fructus naturali magnitudine.
Idem per latum vitreum conspectus.
Fructus horizontaliter dissectus.
Fructus dehiscens, unicapsularis, trivalvis: Semina plurima eorum in medio suspendentibus.
Idem Microscopio visus.
Semina reniformia.
Semina per maturitatem in Capsulam delapsa, ceu in nidum relinquentia.
Tab VI fig 3
Stylus in tria folia petaloidea expansus.
Germen.
Petalon rostrum cui Stamen adhaeret.
Semina tria.
Fructus maturus.
Idem horizontaliter dissectus.
Semina.

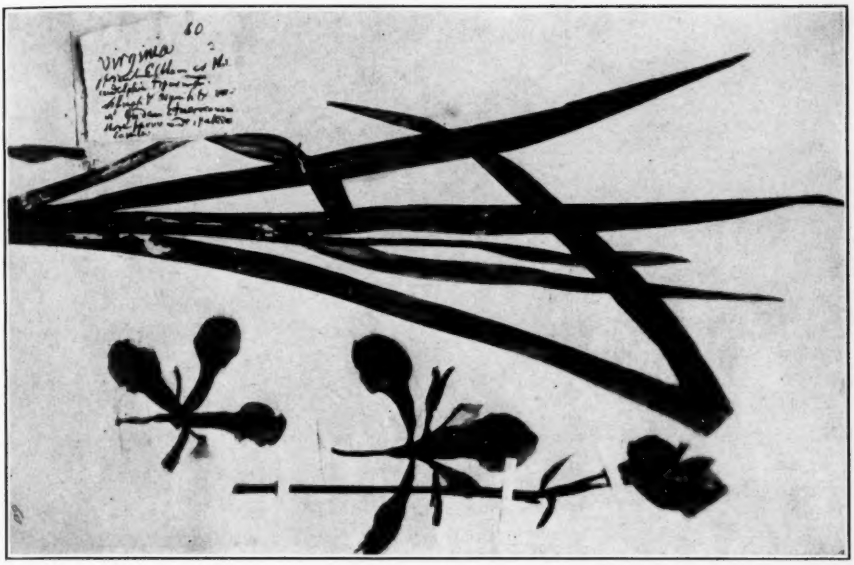
2

Explanation of Plate

PLATE 36

Fig. 1. *Iris versicolor* L. Dillenius' specimen of *Iris americana versicolor*, etc. deposited in the Dillenian Herbarium at Oxford.

Fig. 2. *Iris carolina* Radius. From Radius, W. M., Naturforsch. Ges. Leipzig Schrift. 1: 158. taf. III.



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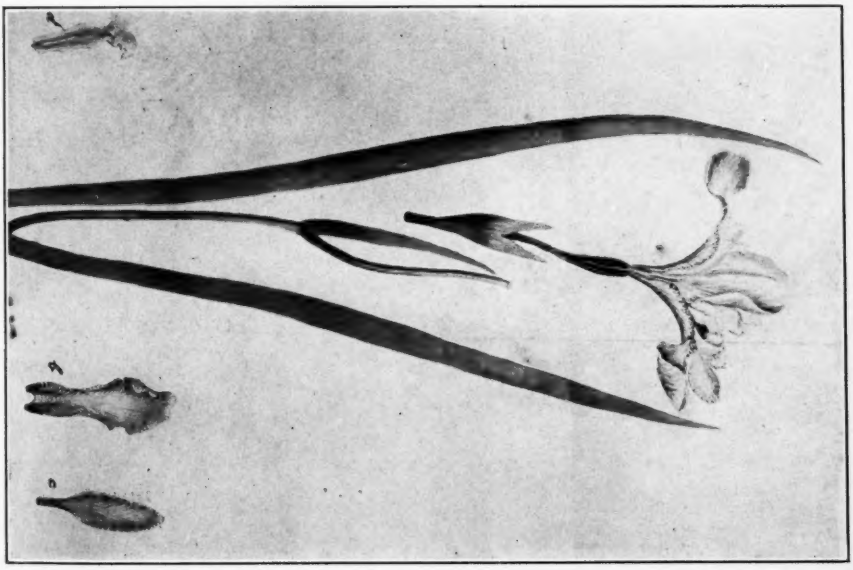


2

Explanation of Plate

PLATE 37

Flowers of *Iris virginica*, × ⅓

Fig. 1. Plant ABC—collected at Orchard Farm, Mo.
Fig. 2. Plant ABC—collected at Orchard Farm, Mo.
Fig. 3. Plant ABC—collected at Orchard Farm, Mo.
Fig. 4. Plant ABC—collected at Orchard Farm, Mo.
Fig. 5. Plant ABC—collected at Orchard Farm, Mo.
Fig. 6. Plant ABE—collected at Fort Madison, Ia.
Fig. 7. Plant ABE—collected at Fort Madison, Ia.
Fig. 8. Plant ABE—collected at Fort Madison, Ia.
Fig. 9. Plant ABQ—collected at Gilbertville, Ia.

ANDERSON—PROBLEM OF SPECIES IN IRIS

Explanation of Plate

PLATE 38

Flowers of *Iris versicolor*, × ⅓

Fig. 1. Plant ABY—collected at Cohasset, Mass.
Fig. 2. Plant ACF—collected at New Haven, Conn.
Fig. 3. Plant ACF—collected at New Haven, Conn.
Fig. 4. Plant BBG—collected at Harmonsburg, Pa.
Fig. 5. Plant collected at Cedar Lake, Nova Scotia.
Fig. 6. Partial albino, var. "Stella Main"—collected in Connecticut.
Figs. 7–9. Seedlings grown at the Missouri Botanical Garden from seed collected at Connecticut Lakes, N. H.

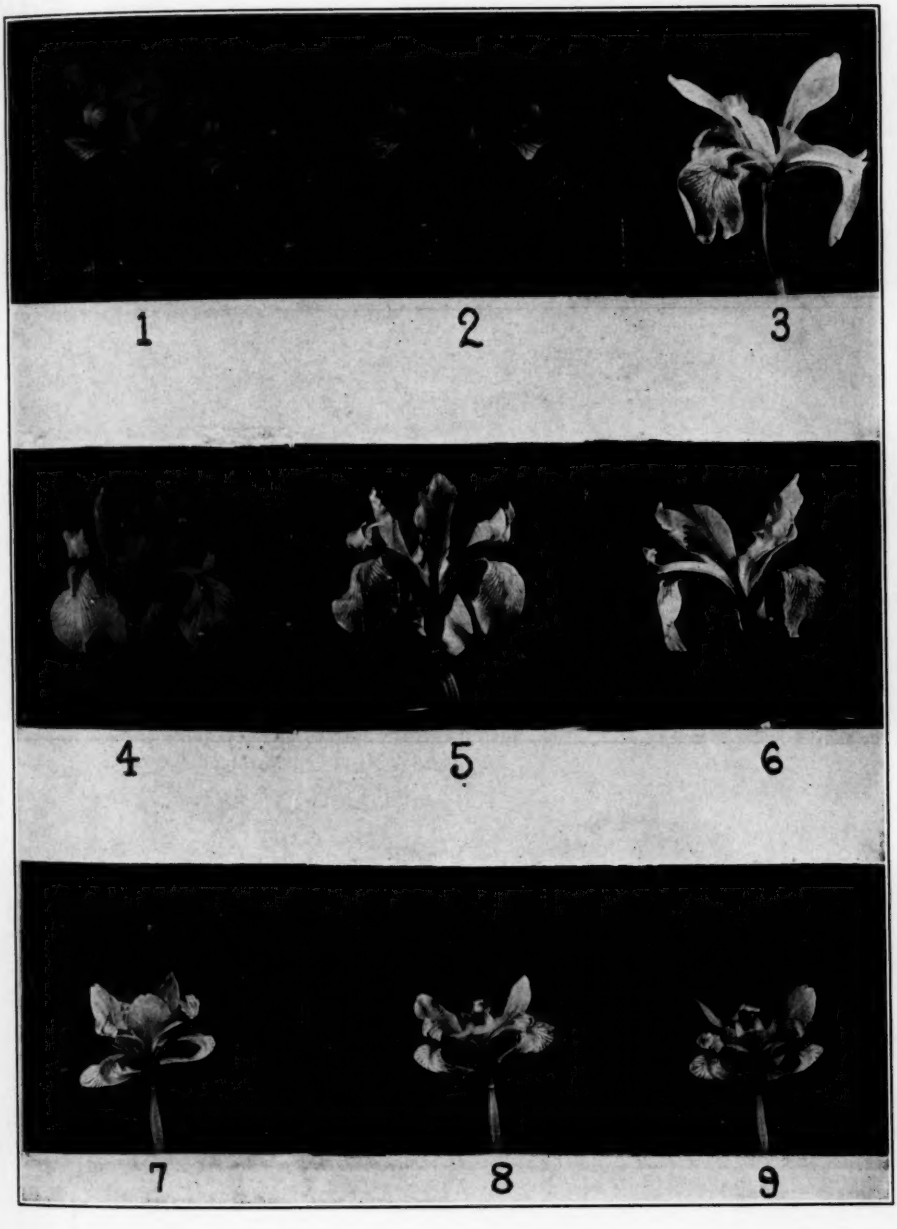
ANDERSON—PROBLEM OF SPECIES IN IRIS

Explanation of Plate

PLATE 39

Flowers of *Iris virginica*, × ⅓.

Figs. 1–2. Plant ABB—collected at Valley Park, Mo.
Fig. 3. Plant ACZ—collected at Fish Creek, Wis.
Fig. 4. Plant ABT—collected at Yale, Mich.
Fig. 5. Plant ABT—collected at Yale, Mich.
Fig. 6. Plant ABT—collected at Yale, Mich.
Fig. 7. Plant ABP—collected at Otisville, Mich.
Fig. 8. Plant ABP—collected at Otisville, Mich.
Fig. 9. Plant ABP—collected at Otisville, Mich.

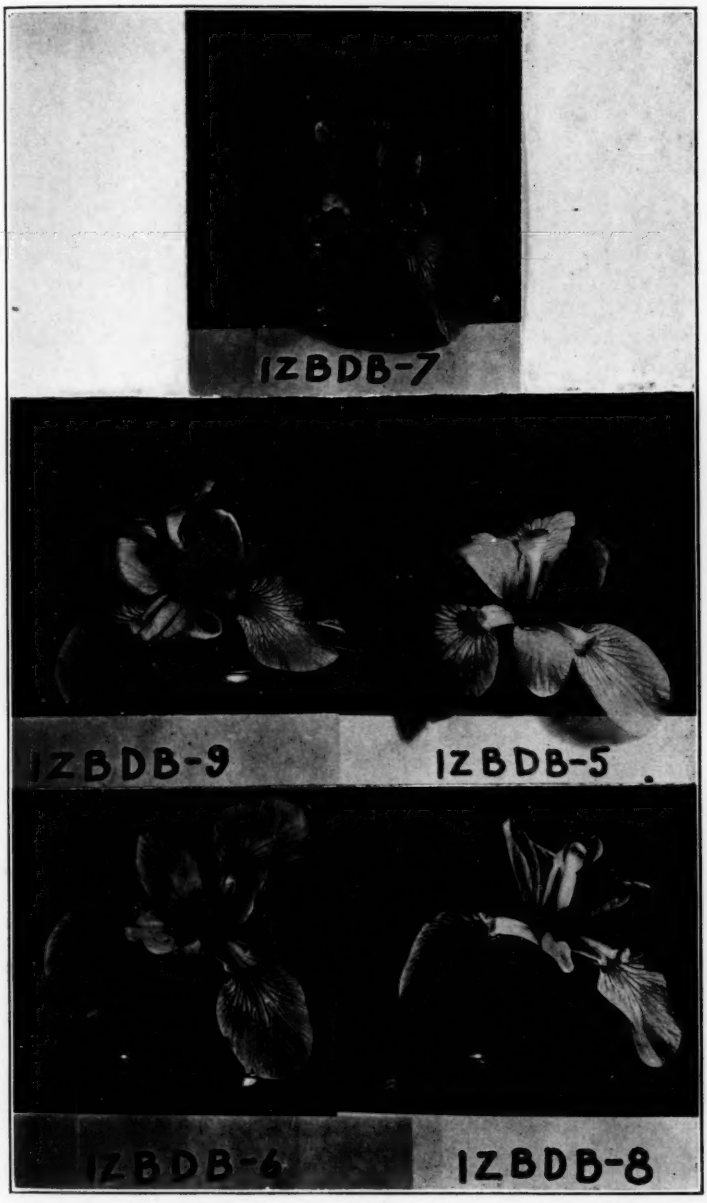


ANDERSON—PROBLEM OF SPECIES IN IRIS

Explanation of Plate

PLATE 40

One flower each of five sister plants of *Iris versicolor* grown at the Missouri Botanical Garden from a seed capsule collected at Connecticut Lakes, N. H.



ANDERSON—PROBLEM OF SPECIES IN IRIS

Explanation of Plate

PLATE 41

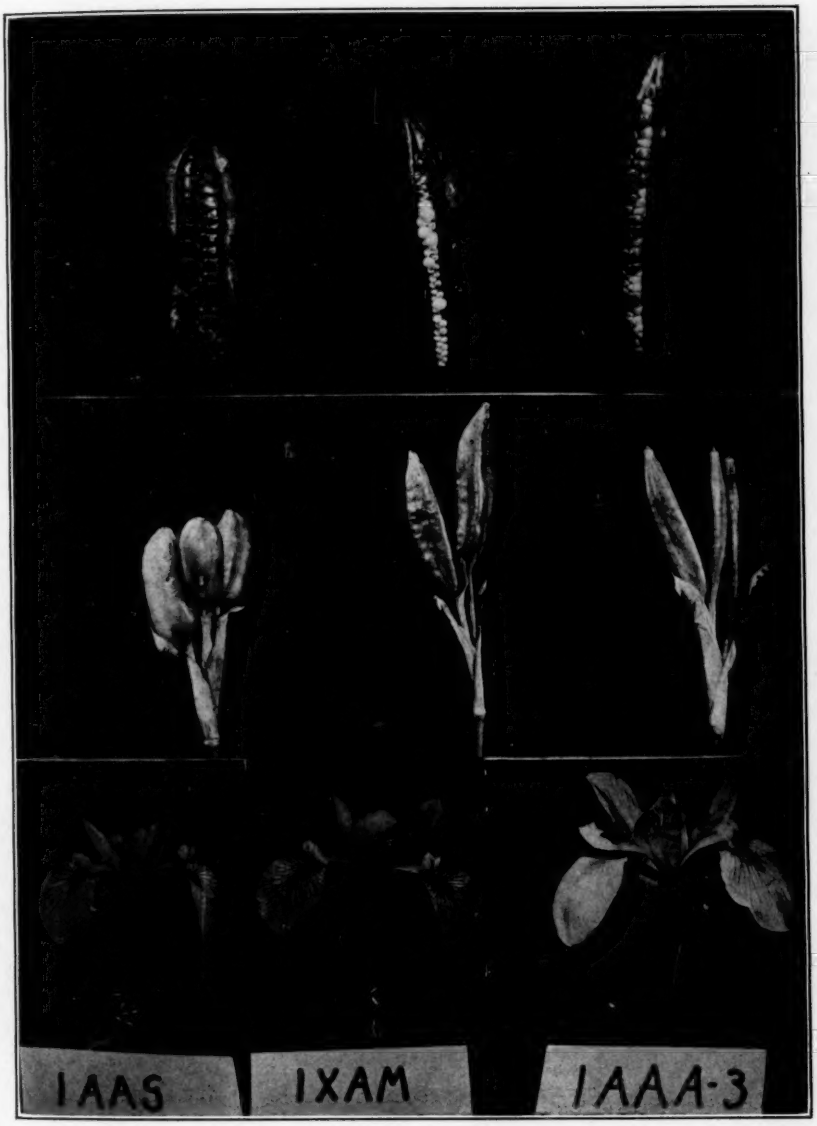
A comparison of *Iris versicolor* and *Iris virginica* with *Iris* × *robusta*, the hybrid between them.

Top row, immature capsules with one locule exposed.

Middle row, immature capsules.

Bottom row, flowers.

In each case the specimen at the left is from plant IAAG (*Iris versicolor*), that at the right from IAAA-3 (*Iris virginica*), and that in the center from their hybrid IXAM (*Iris* × *robusta*).

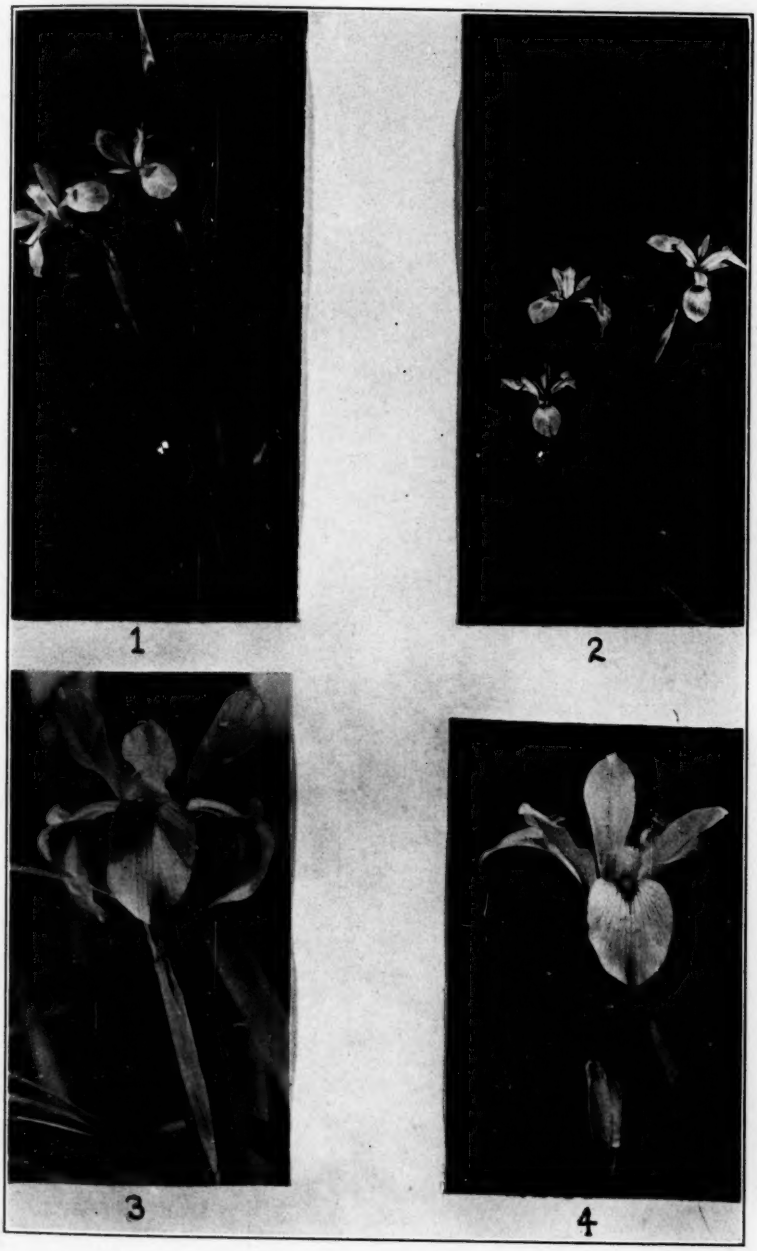


ANDERSON—PROBLEM OF SPECIES IN IRIS

Explanation of Plate

PLATE 42

Fig. 1. Typical flower stalk of *Iris virginica*.
Fig. 2. Typical flower stalk of *Iris versicolor*.
Fig. 3. *Iris virginica* photographed at Huntingdon, Tenn.
Fig. 4. *Iris virginica* photographed at Wilmington, N. C.



ANDERSON—PROBLEM OF SPECIES IN IRIS

EXPLANATION OF PLATE

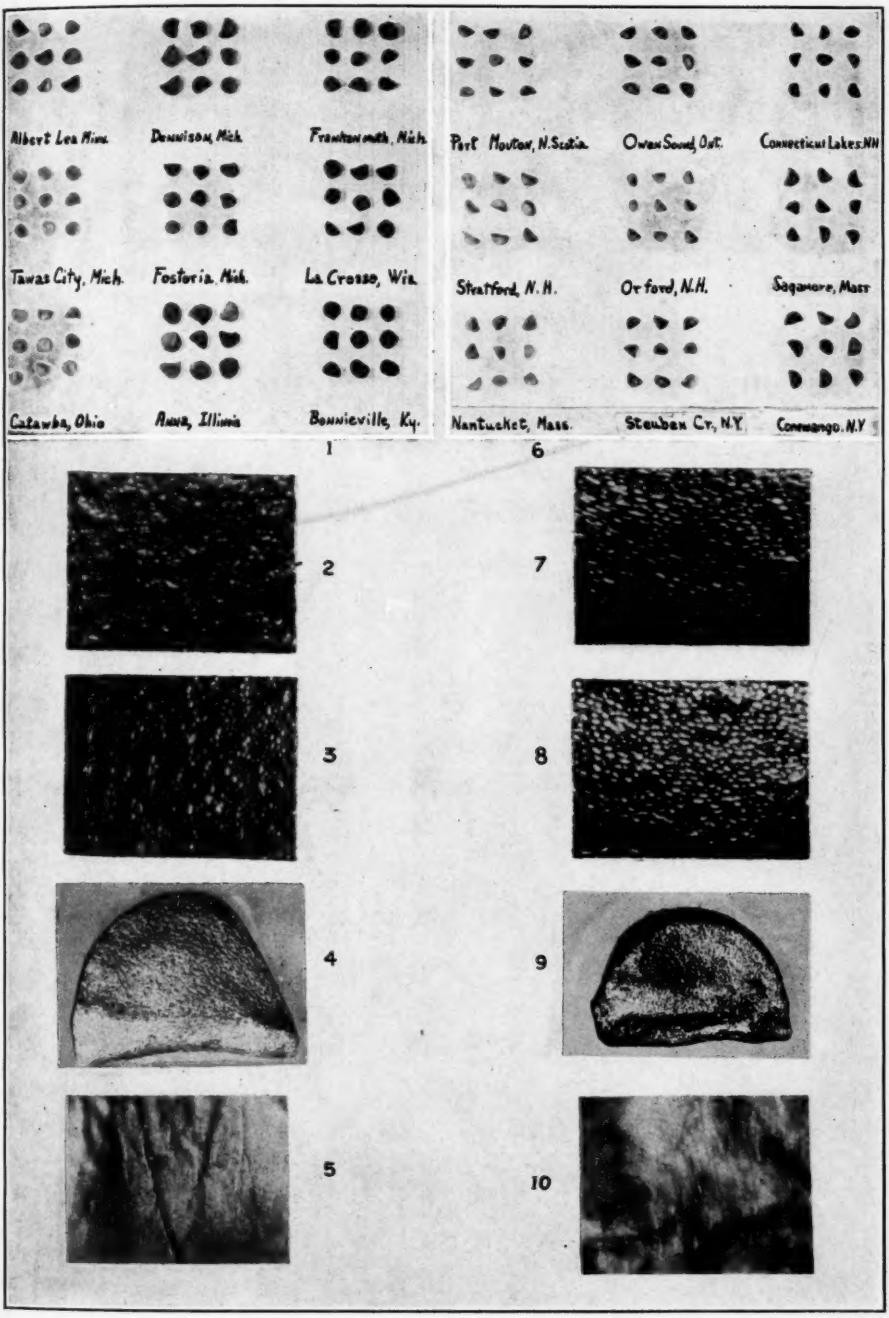
PLATE 43

Figs. 1–5. *Iris virginica.*

Fig. 1. Collected seeds from nine localities, × ½.
Fig. 2. Seed surface (St. Louis, Mo.), × 30.
Fig. 3. Seed surface (Catawba, Ohio), × 30.
Fig. 4. Seed, × 7.
Fig. 5. Lining of seed capsule, × 30.

Figs. 6–10. *Iris versicolor.*

Fig. 6. Collected seeds from nine localities, × ½.
Fig. 7. Seed surface (Sagamore, Mass.), × 30.
Fig. 8. Seed surface (Conewango, N. Y.), × 30.
Fig. 9. Seed, × 7.
Fig. 10. Lining of seed capsule, × 30.



ANDERSON—PROBLEM OF SPECIES IN IRIS

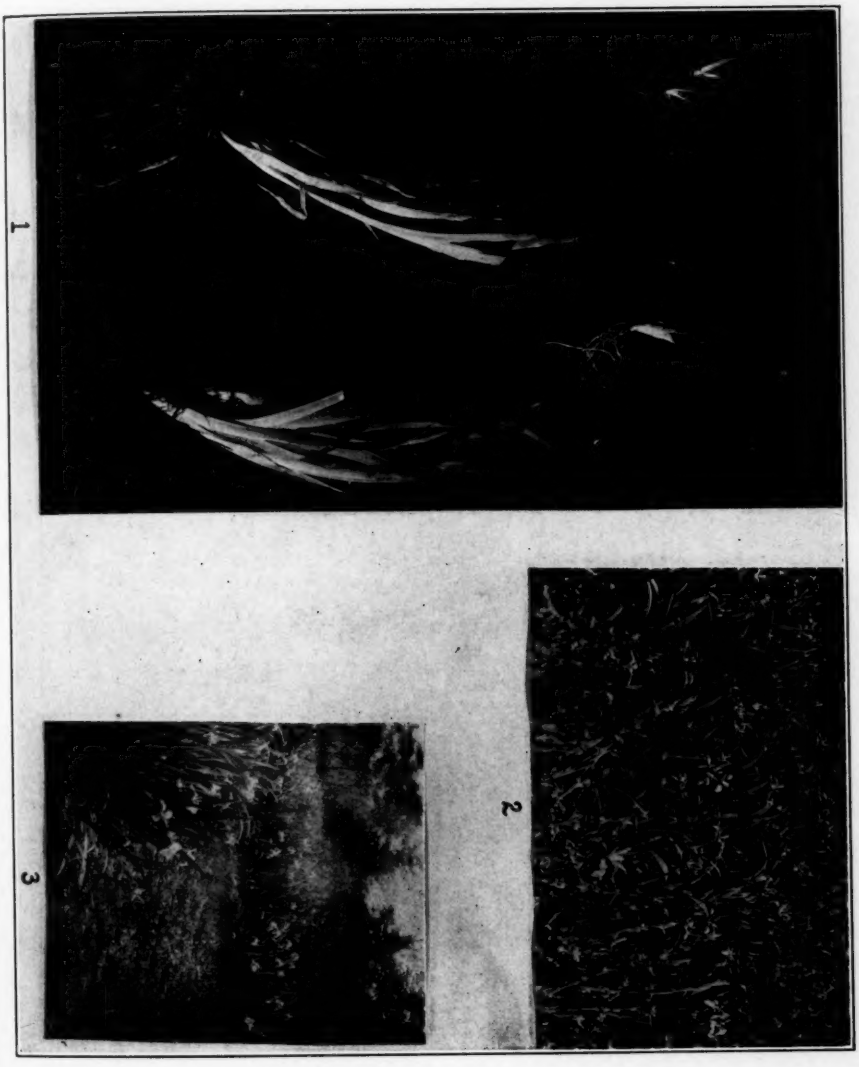
Explanation of Plate

PLATE 44

Fig. 1. Upper row, two plants of *Iris virginica* from Valley Park, Mo., grown in cinders along railroad track; lower row, two plants from the same colony but growing in rich swamp.

Fig. 2. Large single clone of *Iris virginica*, Maysville, N. C.

Fig. 3. Colony of *Iris virginica* at Camden, Tenn.



ANDERSON—PROBLEM OF SPECIES IN IRIS